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THE CURIOUS HOLOTYPE OF *PRISTIS DUBIUS* BLEEKER, 1852 AND THE UNRAVELLING OF BLEEKER'S SAWFISH TAXONOMY

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***ABSTRACT.* –** The recovery of a preserved sawfish caudal fin, which turned out to be the holotype of *Pristis dubius* Bleeker, 1852, prompted a review of Dr. P. Bleeker's publications on the family Pristidae. In his attempt to re-describe his original species *P. zijsron* and *P. dubius*, Bleeker made a number of mistakes that are addressed herein. Contrary to Bleeker's statement, *P. zijsron* and *P. dubius* are synonyms and the former name has priority over the latter. To make Bleeker's works on *Pristis* more accessible, English translations of relevant parts of his papers on Pristidae (in Dutch) and current locations of existing specimens from his original collection are provided. All existing specimens from Bleeker's original collection were also examined.

KEY WORDS. – Bleeker collection, sawfish, type material, Pristidae, *Pristis zijsron*, *P. dubius*, *P. microdon*, *P. semisagittatus*.

INTRODUCTION

During an examination of specimens from the Bleeker collection for a type catalogue of fishes in the collections of the National Museum of Natural History (RMNH), Leiden, the Netherlands, the first author discovered a loose caudal fin of an elasmobranch hidden in the eviscerated abdominal cavity of a complete sawfish (Pristidae). The loose caudal fin and the caudal fin of the complete specimen were very similar (Fig. 1). The specimens (RMNH 7418) labelled "*Squalus dubius* Bleeker, 1852" were stored in an original "A" series jar (Whitehead et al., 1966: 6) from the Bleeker collection. This jar was bought at the 1879 auction of the Bleeker collection (Hubrecht, 1879). Due to its unusual storing place, the caudal fin had escaped the attention of previous curators. The discovery of this caudal fin called attention to the possibility that this unusual specimen might be the one on which Bleeker based his description of *Pristis dubius* Bleeker, 1852 (Bleeker, 1852a).

Pristis dubius was not the only sawfish species described by Bleeker based on an isolated anatomical part. Some months before the publication of his description of *P. dubius*, Bleeker (1851b) described *Pristis zijsron* based solely on one isolated rostrum, or saw. The saw is now registered as RMNH D 7418 (Fig. 2). Compounding the taxonomic confusion caused by sawfish identification based on such poor and incomplete species descriptions, the scenario became even more complicated when Bleeker had access to additional specimens and redescribed *P. zijsron* (Bleeker, 1852b). Today, much of the taxonomic uncertainty that troubled Bleeker has been resolved (*P. dubius* is considered a junior synonymy of *P. zijsron*). However, it is clear that in naming a new species of *Pristis*, Bleeker made a number of mistakes that have not yet been properly addressed by subsequent ichthyologists working on Pristidae. The discovery of the lost type specimen of *P. dubius* was embraced as an opportunity to revisit the subject of the work of Dr. Pieter Bleeker on the sawfishes.

The main goal of the present study is to review the contribution of Dr. Bleeker to sawfish taxonomy. The specific goals of this research are to review the work of Bleeker in describing and re-describing new species of sawfish (i.e., *Pristis zijsron* and *P. dubius*) and to address their taxonomic implications. This is based on an analysis of Bleeker's original publications and historical specimens deposited in museum collections. An additional goal is to make Bleeker's work on sawfish more accessible to other researchers by providing: a) English translations of relevant sections of Bleeker's publications on sawfishes and b) the current locations of

existing specimens derived from Bleeker's original collection.

MATERIALS AND METHODS

All of Bleeker's literature material dealing with sawfishes was examined. This included original manuscripts, original printed publications and original plates of depicted specimens, reprint series of the same original publications and one unpublished annotated handwritten manuscript. All literature material examined is part of the RMNH reference collection. Texts or sections in Dutch, French and Latin were translated into English. Relevant sections of the translated texts are provided.

A total of 12 specimens collected by Bleeker deposited at the Nationaal Natuurhistorisch Museum (RMNH), Leiden (n = 8), The Museum of Natural History (BMNH), London, (n = 3), and the Museum Nationale d' Histoire Naturelle (MNHN), Paris (n = 1), were examined. Identification of species followed Last & Stevens (1994). While examining the specimens of Bleeker, close attention was paid to any subtle historical clues still visible on the specimens, such as original labels or special ink marks.

Although the authors acknowledge that, in most cases, Bleeker's original nominal species identifying specimen jar labels (the original identification) and citations in text and figure legends of his publications are not valid today; his original names will be reproduced throughout this present work. This was done in order to preserve historical information and also due to doubts about which valid species they represent. If an actual specimen was examined and identified, the current valid species name is indicated in square brackets. Research into the taxonomy of Bleeker's identification of sawfishes and historical taxonomy significance is still ongoing (Faria & McDavitt, in preparation). Abbreviations herein used are: TL = total length.

REVIEW OF THE HISTORY OF BLEEKER'S PUBLISHED ACCOUNTS ON SAWFISH WITH EMPHASIS ON HIS DESCRIPTIONS AND REDESCRIPTIONS OF *PRISTIS* SPECIES

From 1851 to 1875, Bleeker published 12 manuscripts that cited sawfish specimens. The first four (Bleeker, 1851b, 1852a, 1852b, and 1853) were the most relevant in terms of sawfish taxonomy. All taxonomic descriptions of sawfishes made by Bleeker are found in these references. In his later works, sawfish species were only mentioned in checklists of South Indo-West Pacific fishes (Bleeker, 1855, 1856a, 1856b, 1860, 1861, 1865) and in papers on fishes of China (Bleeker, 1873) and Madagascar (Bleeker, 1875). Bleeker had drawings

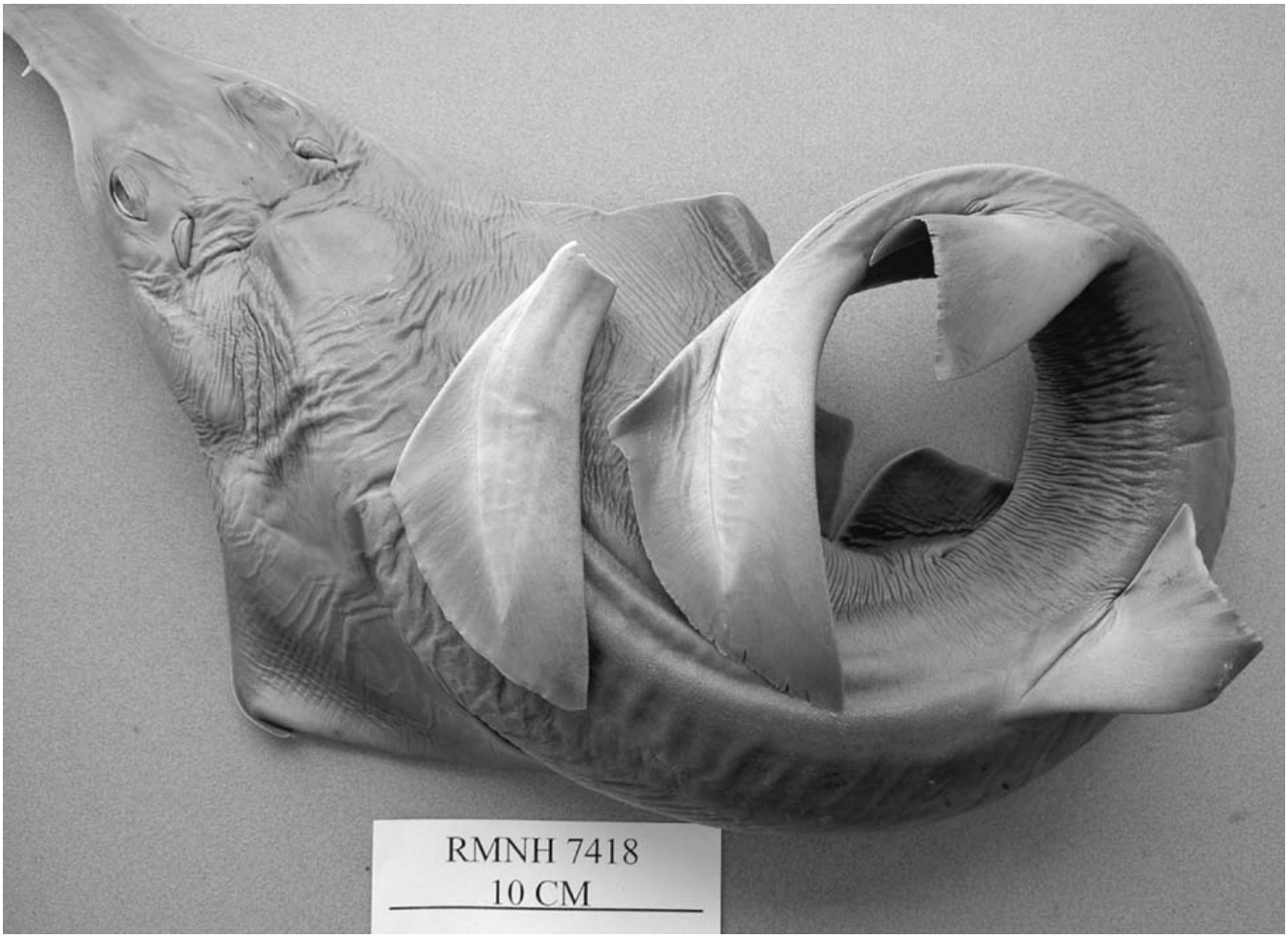

Fig. 1. The loose caudal fin and the caudal of the only complete specimen of *Pristis dubius* in Bleeker's collection (RMNH 7418). Specimen dorsal view, caudal fins lateral view.

of *Pristis* species prepared for his Atlas Ichthyologique, that were only published recently (Bleeker, 1983) (see Fig. 5). Unfortunately, the sawfishes are among the groups which were not revised for the Atlas. Below is a chronological review of Bleeker's sawfish accounts, consisting of translations of original relevant sections and comments on pertinent issues:

Bleeker, 1851b. "Vijfde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen" ***[= Fifth contribution to the ichthyological fauna of Borneo, with descriptions of some new species of fresh water fishes]*** **–** The first paper by Bleeker in which a *Pristis* species was mentioned, was written in August 1851 (Bleeker, 1851b) and according to Bleeker (1878), published in the same year. In this paper, Bleeker gave a short description of his new species, *Pristis zijsron*. The description was based on an isolated saw (rostrum) from Bandjermassing, Borneo. This saw had a total length of 390 mm and had 26 pairs of rostral teeth (Fig. 2). The Dutch remark accompanying the Latin description is translated as follows:

"*Of this species, I possess only one saw, from the tip to 38 mm behind the last teeth. The width of the saw at the anteriormost teeth is 27 mm, at the 13th tooth 37 mm, and at the last teeth 48 mm. The colour of the saw on the upper side is sea green. This saw does not resemble that of any of the existing species of* Pristis."

Although this paper contained the first published description of *P. zijsron*, neither Bleeker nor any of his contemporaries ever referred to it.

Bleeker, 1852a. "Bijdragen tot de kennis der Plagiostomen van den Indischen Archipel" ***[= Contribution to the knowledge of the Plagiostomi of the Indian Archipelago]*** **–** In a review of the sharks and rays of the Indian archipelago [= Indonesia], Bleeker (1852a) mentioned five species of sawfishes occurring in the area: *Pristis cuspidatus* (Latham, 1794), *P. dubius* (Bleeker, 1852), *P. microdon* (Latham, 1794), *P. semisagittatus* (Shaw, 1804) and *P. zijsron* Bleeker, 1851. Among these, *P. dubius* was a new species described for the first time, based on a detached caudal fin. There was evidence that Bleeker possessed specimens of all the nominal species mentioned except *P. cuspidatus* (e.g. complete specimens of *P. semisagittatus* and *P. microdon*, a saw of *P. zijsron* and a caudal fin of *P. dubius*). He knew about the presence of *P. cuspidatus* in the region from literature. In the introduction to the Squatinorajae, Bleeker (1852a: 49) states [translated from Dutch]:

"…. *of these species* Pristis zijsron *and* Pristis dubius *have been described on the basis of a saw and a caudal fin only, so that new observations are required to decide whether they can be included forever or not in the list of names. Therefore, their names for the time being will have to be considered as provisional.*"

On p. 8 Bleeker refers to "*Pristis dubius* Bleeker (an. spec. div.?)".

In order to distinguish the four species in his collection belonging to his Phalanx Pristides, Bleeker (1852a: 51) gives the following key [translated from Latin]:

Pristis *Lath.*

I. Scales on the body inconspicuous. First dorsal fin placed entirely behind ventral fins.
A. Saw teeth with arrow point on one side, last quarter of the saw devoid of teeth.
Pristis semisagittatus *Cuv.*

II. Scales on the body conspicuous. First dorsal fin originates anterior to ventral fins.
A. Saw teeth short without arrowed tip, distance between

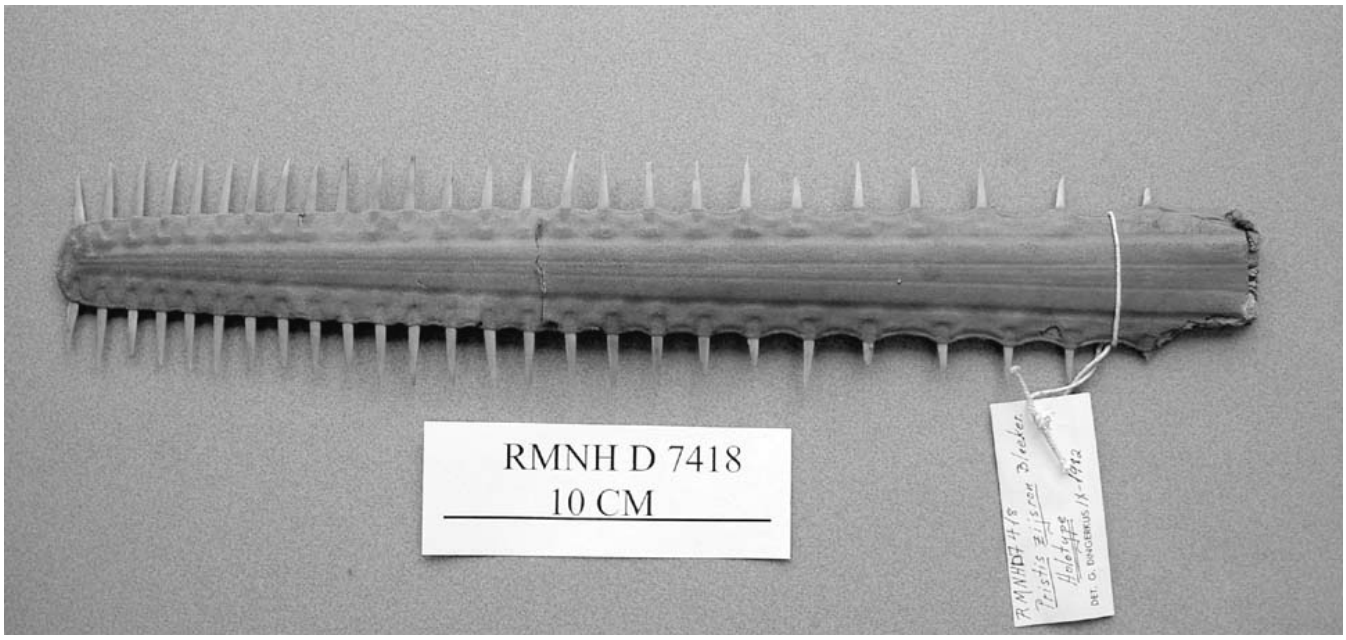

Fig. 2. The holotype of *Pristis zijsron* Bleeker, 1851 (RMNH D 7418), dorsal view.

the teeth more than their own length, basal half of teeth united by a membrane.

Pristis microdon *Lath.*

? *Saw teeth long and slender without arrowed tip, the anterior ones separated by a distance of less than half their length, the posterior ones separated by a distance more than their own length.*

Pristis zijsron *Blkr.*

? *Caudal fin with convex posterior margin, ventral margin less than twice the size of upper margin and caudal margin a little shorter.*

Pristis dubius *Blkr."*

On pp. 53 - 56 diagnostic descriptions of these four species are given. The description [in Latin] is followed by data on the habitat, sex and size of his specimens, with remarks [in Dutch]. These notes in Dutch (except for the part concerning the gastrointestinal anatomy) are translated as follows:

Pristis semisagittatus
Collected in Batavia, Samarang, in sea.
Length of the 2 described female specimens 600 and 730 mm.

"Remarks. This easily recognisable species, besides the coasts of Java, also inhabits the coasts of Singapore, Pinang, Malacca, Coromandel [= East coast of India] *and Bengal. I possess 3 female specimens, two in a perfect state from which the above description is taken and one with the saw cut off. This last specimen without a saw has a length of 670 mm."*

Pristis microdon
Collected in Batavia, Gresik, in the sea. Soerakarta, Central Java and Bandjermassing, Southeast Borneo, in rivers.
Length of a single female specimen 860 mm.

"Remarks. This species not only lives in the sea, but also, like Pristis Perroteti [perotteti] *Müller & Henle, 1841 in freshwater. I observed it in 1846 in Soerakarta, [Java] where it was caught in the Kali [=river] Pepeh, which discharges itself there into the large Solo river. In Batavia it is brought to the market from time to time, but less often than* Pristis semisagittatus *and usually with the saw cut off. I have seen specimens without a saw of at least 1700 mm length.*
From Bandjermassing, I received a saw of this species of 280 mm length, which has 18 teeth on one side and 19 teeth on the other side of the saw."

Pristis zijsron
Collected in Bandjermassing, Southeast Borneo, in river.
Length of the described saw 390 mm.
"Remarks. Of this species, I possess only one saw, from the tip down to 38 mm behind the last teeth. The width of the saw near the anteriormost teeth is 27 mm, at the 13th tooth 37 mm and at the last teeth 48 mm. The colour of the saw on the upper side is sea green. The differences between this saw and the saws of the other known species of Pristis *are as follows:*
Pristis pectinatus *Latham 1794 - Teeth with a groove on the posterior side. The anterior teeth as long as the width of the saw.*
Pristis semisagittatus - *Teeth arrow-like (with a single hook).*
Pristis Perroteti [perotteti] - *Teeth with a groove on the posterior side, the width of the anterior ones larger than half the width of the saw.*
Pristis cuspidatus - *Width of the saw nearly equal almost everywhere. Teeth lancet shaped, their length hardly longer than their width. Space between most teeth not larger than the width of the teeth.*
Pristis microdon - *Teeth united by a membrane at their bases. Space between teeth larger than their length. Length of the teeth 3 to 8 times smaller than the width of the saw at the place of implantation.*
Pristis antiquorum *Latham 1794 - Teeth directed slightly backwards, with a more or less distinct groove on the posterior side."*

An intriguing detail of this description is that it begins with what seems to be a copy of the text used in the original (first published) description of this species (Bleeker, 1851b), followed by a detailed comparison between the *P. zijsron* saw and the saws of other sawfish species. It is important to note here that the manuscript of the first 90 pages of Bleeker's Plagiostomen paper was **finished in June 1851**; Scripsi Batavia Calendis Junii MDCCCLI (Bleeker, 1852a: 90), but an appendix, consisting of 2 pages, was added later and it delayed the publication of this manuscript, which was **published in 1852** (Bleeker, 1878). However, Bleeker's manuscript on fishes of Borneo was **finished in August 1851**; Scipsi [Sic.] Batavia Calendis Augusti MDCCCLI (Bleeker, 1851: 442) and **published in this same year** (Bleeker, 1878). Therefore, although we must recognize that this paper (Bleeker, 1851b) is the paper that contains the first published description of *P. zijsron,* this description is a copy of the one in Bleeker (1852a) and not the reverse.

Pristis dubius

"Of this species, I only possess the caudal fin, because, when I saw it, I failed to place the whole specimen in my collection. It was brought to the market without a saw, which is usually cut off by the fisherman when the fish is caught. Therefore, I cannot say anything about it. The caudal fin does not resemble that of any of the species of Pristis *known to me (i.e.,* Pristis antiquorum, Pristis microdon *and* Pristis semisagittatus*. In their work on the Plagiostomen, Mr. J. Müller and Henle are completely silent concerning the caudal fin of* Pristis cuspidatus [sic.] *and* Pristis pectinatus*, whereas concerning* Pristis Perroteti [perotteti] *Val. [Müller & Henle, 1841] they only remark that its caudal fin has a short but clear ventral lobe. The distinguishing character of the caudal fin* [*of* P. dubius] *lies in the context of its caudal margin and the length of its ventral margin and in the distinct visibility of its scales. I believe this species is closely related to* Pristis microdon*, but it is clearly a different species. In the accompanying figure, one can see the outline of the caudal fin of this dubious species and of* Pristis microdon*, both of about equal length. Possibly this dubious specimen belongs to* Pristis zijsron *of which I possess only one saw. Until more*

detailed observations are made concerning the status of this species, I propose to call it Pristis dubius*. The knowledge of the species of* Pristis *is still very incomplete, therefore it is not superfluous to draw it to the attention of the zoologists."*

In the caption of the accompanying figure (Pl. IV, Fig. 11) (see Fig. 3), the name *Pristis dubia* is used.

The size and shape of the detached caudal fin found within specimen RMNH 7418 closely matches the original figure of the caudal fin of the *P. dubius* holotype (Fig. 3). While the outline of the fin matches very closely, the similarity in size is also a crucial factor. This is because Bleeker would depict specimens in their natural size whenever possible. It is important to note that in the reprint series of Bleeker's papers by Lamme (1975), page sizes were reduced and therefore figures are smaller than the actual size. Therefore, only the original publication should be referred to for the identification of a holotype based on size. The caudal fin is now registered as RMNH 34134, holotype of *P. dubius*. Despite its importance as holotype, it is not surprising that the loose fin did not possess a tag or any other form of identification. This is because Bleeker never labelled his type specimens or the jars in which they were contained in any special way (Whitehead et al., 1966). The only written evidence of the historical identity of this caudal fin is the label on the jar ("*Squalus dubius*"), assuming that it refers to both the complete sawfish specimen and the detached caudal fin contained in it.

Bleeker, 1852b. "Zesde bijdrage tot de kennis der ichthyologische fauna van Borneo. Vissen van Pamangkat, Bandjermassing, Praboekarta en Sampit" ***[= Sixth contribution to the knowledge of the ichthyological fauna of Borneo. Fishes from Pamangkat, Bandjermassing, Praboekarta and Sampit]*** **–** Later in 1852, Bleeker (1852b) published a redescription of *P. zijsron* based on a more complete specimen: a saw attached to the head and skin (900 mm TL) again from Bandjermassing, Borneo. The Dutch remark following the description can be translated as follows:

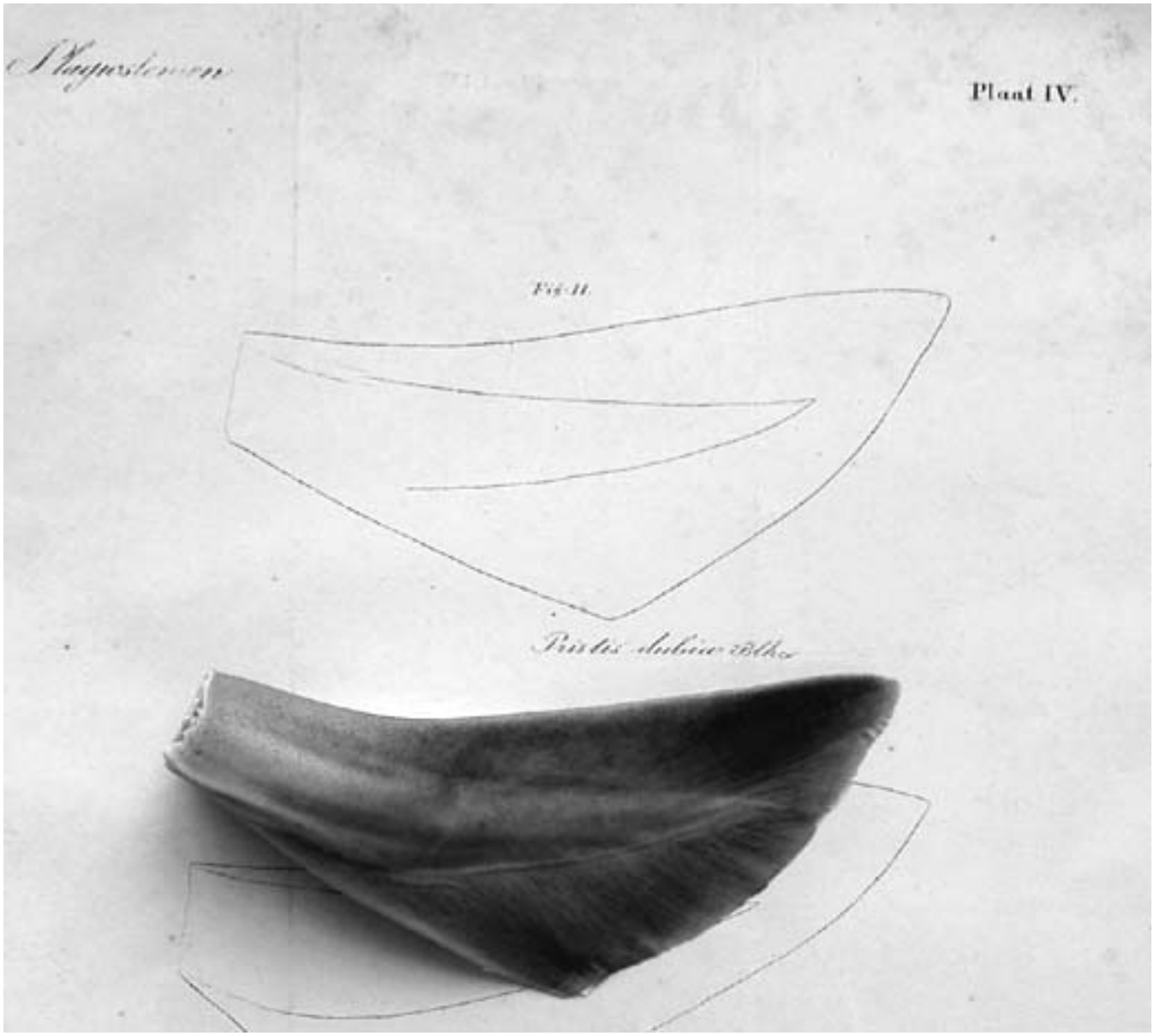

Fig. 3. The holotype of *Pristis dubius* Bleeker, 1852 (RMNH 34134), lateral view, with its outline drawing from Bleeker, 1852a.

"I have described the saw of this species in my Bijdrage tot de Kennis der Plagiostomen van den Indischen Archipel, included in Vol. 24 of the Verhandelingen van het Bataafs Genootshap van Kunsten en Wetenschappen. [Bleeker does not refer to the description in Bleeker (1851)] *Thereafter, I received a saw with the head and skin of a specimen of the same species. The saw of this specimen is remarkably shorter and has a length of only 222 mm from the tip to the last tooth and moreover, it has 6 teeth less on each side."*

This (head and skin) specimen is currently deposited in the fish collection of The Natural History Museum, London (BMNH 1867.11.28.185) under the name of *P. zysron*. An examination revealed that it is a specimen of *P. microdon* (Latham, 1794) (Fig. 4). Therefore, Bleeker was wrong when he considered this specimen conspecific with the saw described as *P. zijsron* in 1851 and in 1852 (Bleeker, 1851b, 1852a).

Bleeker, 1853. 'Zevende bijdrage tot de kennis der ichthyologische fauna van Borneo. Zoetwatervissen van Sambas, Pontianak en Pangaron" ***[= Seventh contribution to the knowledge of the ichthyological fauna of Borneo. Fresh water fishes from Sambas, Pontianak and Pangaron]*** **–** In 1853, Bleeker realized that the saw on which he based the first description of *P. zijsron* Bleeker, 1851 was not the same species as the head and skin specimen [which is a *P. microdon*] described in Bleeker (1852b). This is because he had access to a complete specimen [of what we call today *P. zijsron*, see below] for the first time. The specimen had the combination of characters of the isolated saw described as the holotype of *P. zijsron* in Bleeker (1851) and (1852a) with those of the caudal fin described as the holotype of *P. dubius* in Bleeker (1852).

Bleeker was then faced with the following situation: a) the original holotypes of *P. zijsron* and *P. dubius* (Bleeker, 1851 and 1852a, respectively) in reality belonged to a single species and; b) the specimen on which he based the redescription of *P. zijsron* (Bleeker, 1852b) is a second species. When faced with a similar situation, present day researchers would first of all conclude that *P. zijsron* (published in 1851) would have priority over *P. dubius* and therefore, *P. dubius* would then be considered a junior synonym. Secondly, the (head and skin) specimen would then be considered a species still in need of a name and would probably be redescribed again under a new name. However, Bleeker tackled this problem in a different way. He used the new specimen to make a redescription of *P. dubius.* In this redescription, he concluded that the isolated saw specimen described as *P. zijsron* in Bleeker (1851b) was a synonym of *P. dubius* (the caudal fin specimen). Bleeker (1853: 459) cited the same page number (Bleeker, 1852a: 56) for the description of *P. zijsron* and *P. dubius*, whereas *P. zijsron* was actually described on page 55. Remarkably, this page number was cited correctly in Bleeker (1852b: 441). The original description of *P. zijsron* was cited in none of these papers. Bleeker retained the name *P. zijsron* for the (head and skin) specimen described in Bleeker (1852b).

The Dutch remarks added to the redescription of *P. dubius* are translated as follows:

"In my Bijdrage tot de kennis der Plagiostomen van den Indischen Archipel, I erected two new species of Pristis*, i.e.,* Pristis dubius *on the basis of a caudal fin that was in my possession and* Pristis zijsron *only on the basis of a saw. However, I stated there that perhaps this caudal fin and the saw belonged to a single species. This supposition has turned out to be certainty because in Batavia, I found a complete perfect example of* Pristis dubius*, whose saw was completely similar to the saw on which I based* Pristis zijsron.

On the other hand, after the appearance of my contribution on the Plagiostomii in the third Volume of the Natuurkundig Tijdschrift van Nederlandsch-Indië (p. 441 & 442), I described a species of Pristis *as* Pristis zijsron*, which indeed differs from* Pristis dubius *by its relatively much longer saw, which fits hardly 3½ times in the length of the body and has on both sides only 20 teeth and a concave caudal fin, the ventral margin of which fits 1½ times in the length of the caudal margin. To this species I erroneously have brought the saw with 26 teeth on each side, which I earlier had described as* Pristis zijsron. *Considered separately, the saws of both species do not differ markedly unless by the number of teeth. I now believe to have sufficiently characterised* Pristis dubius *and* Pristis zijsron *as separate species."*
[The remarks continue with a detailed description of the intestines of *P. dubius*, which is not relevant to this paper].

It is likely that the specimen RMNH 7418 (Fig. 1), which still bears an original Bleeker label with the name "*Squalus*

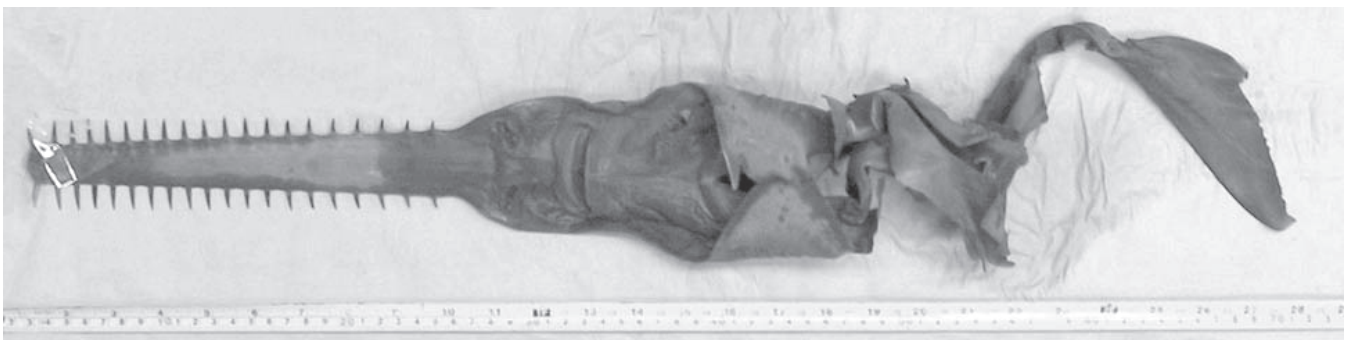

Fig. 4. The first "complete" specimen of *Pristis zysron* (900 mm TL) from Banjermassing Borneo, on which the redescription of *P. zijsron* was based (BMNH 1867.11.28.185), ventral view.

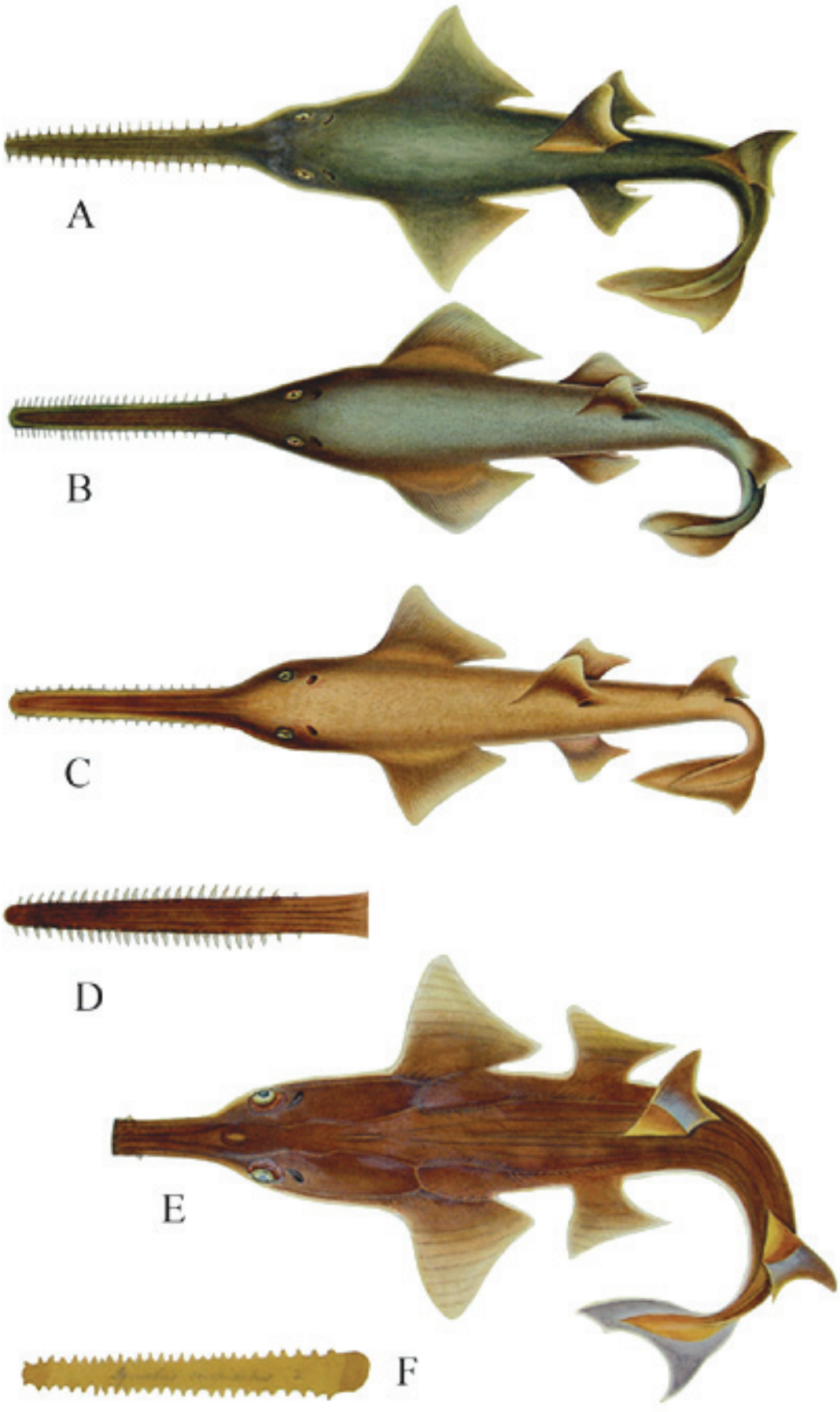

Fig. 5. A compilation of the original drawings of sawfishes meant for the Atlas Ichthyologique. A) *Squalus zijsron* [= *Pristis microdon*], B) *S. dubius* [= *P. zijsron*], C) *S. microdon*, [= *P. microdon*], D) *S. semisagittatus* [= *Anoxypristis cuspidata*], E) *S. semisagittatus* [= *A.cuspidata*], F) paper cutting of saw of *S. cuspidatus* after Latham, 1794 [= *A. cuspidata*].

dubius Bleeker", is the specimen mentioned by Bleeker (1853). Probably not by coincidence, this is the specimen in which the caudal fin, the holotype of *P. dubius* was found.

***Later publications.* –** In a compilation of the fish species known from Borneo, Bleeker (1860) lists *P. dubius, P. microdon* and *P. zysron*. In four papers dealing with the ichthyological fauna of Ambon, Bleeker mentions three sawfish species namely, *P cupidatus*, *P. dubius* and *P. zysron*. Bleeker only examined specimens of the last two species and of these two, only a specimen of *P. dubius* was added to his collection (Bleeker, 1855, 1856a, b, 1865).

In a list of fish species known from Amboina, Bleeker (1865: 270, 271) mentions three species in the family "Pristidioidei". Without explanation, (but possibly following Shaw, 1804) they are now placed in the genus *Squalus*, namely, *S. cuspidatus*, *S. dubius* and *S. zysron.* Bleeker (1873) mentions a single species placed in *Squalus* (i.e., *S. cuspidatus*), but in his last publication in which sawfishes are mentioned (Bleeker, 1875), the genus *Pristis* is used again.

***Unpublished information.* –** An unpublished manuscript held in the archives of the National Museum of Natural History, Leiden, Bleeker (1869, 1877) lists five species in his family "Pristidoidei". Although Bleeker in 1869 (written in ink) placed the species in the genus *Squalus* (without subgenus *Pristus*), he changed it in 1877 (in pencil) to *Pristis* again. The listed species are:

-*Pristis cuspidatus* Lath
Hab. Sumatra, Pinang, Amboina, Tenameren
-*Pristis dubius* Blkr
Hab. Java, Borneo, Amboina, sea and rivers
-*Pristis microdon* Lath = *P. Perroteti* [*perotteti*] MH = *P. antiquorum* Costo. = *P. zijsron* Blkr N.T.N.I. III p 442 (nec Verh. B.G.) [= Bleeker, 1852b, not Bleeker, 1852a]
Hab. Java, Borneo, sea and rivers
-*Pristis semisagittatus* Shaw = *Pristis semisagittatus* Lath (see Gthr fact. cuspidati)
Hab. Sumatra, Pinang, Singapura, Java, Malacca, Bengal, Hindostan
-*Pristis zijsron* Blkr, (V.B.G. xxiv Plag. 55 nec Nat T. N. I. III p. 442) [= Bleeker 1852a, not Bleeker 1852b)
Hab. Borneo, Amboina, sea and rivers

In this unpublished manuscript, Bleeker, probably as a result of his correspondence with Günther: 1) places the (head and skin) specimen (now BMNH 1867.11.28.185) described as *P. zijsron* in the Natuurkundig Tijdschrift voor Nederlansch-Indie III, p 441 (Bleeker, 1852b) in the synonymy of *P. microdon* and; 2) treats the saw he described as *P. zijsron* in the Verhandelingen van het Bataafs Genootschap van Kunsten en Wetenschappen, p. 55 (Bleeker, 1852a) again as a separate species (no longer in the synonymy of *P. dubius*.).

***Application of the rules of the International Code of Zoological Nomenclature to Bleeker's papers*. –** As the name *P. zijsron* was published before *P. dubius*, *P. zijsron* has priority (1851 versus 1852). Even if the original description of *P. zijsron* (in Bleeker, 1851) is not taken into account, the name *zijsron* has page priority (page 55 versus page 56). When Bleeker (1852b) concluded that the saw of *P. zijsron* and the caudal fin of *P. dubius* belonged to one species, he should have named it *P. zijsron*. Following the International Code of Zoological Nomenclature (ICZN), *P. dubius* must be considered a junior synonym of *P. zijsron*.

When Bleeker (1852b) used the name *P. zijsron* in a redescription of the species, he believed that the saw and the complete specimen belonged to one species. However, when Bleeker (1853) referred to the complete specimen as *P.*

Fig. 6. Saw of RMNH 7419, auction name *Squalus (Pristis) zijsron* [= *P. microdon*], dorsal view.

zijsron, while stating that the complete specimen and the saw were from different species, he made another mistake — the name *zijsron* was attached to the saw and after he referred to the saw and the caudal fin as a single species, it was no longer available. When he used it again for the complete specimen, it became an objective homonym. This means that the specimen he referred to in 1853 and used for the redescription of *P. zijsron* in 1852 has no valid name. [A new name would have been be required if re-examination of this specimen (BMNH 1867.11.28.185) reveals that it is a new species. However, no such action is needed as Faria (personal observation) has identified it as *P. microdon* Latham, 1794.]

The spelling of "zijsron". **–** Bleeker was very inconsistent with the spelling of "*zijsron*". In the original description (Bleeker, 1851b), "ij" (the Dutch "y") is used, but in subsequent papers, both "ij" and "y" are used, sometimes even in a single paragraph (Bleeker, 1853: 460). A similar mixing of these characters occurs in other specific, generic and higher group names as well (e.g., see Bleeker, 1851a). This might be the case that typesetters had problems deciphering Bleeker's small and cramped writing. It is also possible that Bleeker (who was the editor of many periodicals in which he published his papers) did not do a proper job in proofreading his manuscripts. Bleeker gives no explanation of the name *zijsron* and its derivation is unclear. Research into the etymology of *zijsron* and the taxonomic significance of Bleeker's usage of this term is still ongoing.

Subsequent use of the names dubius and zijsron. **–** Duméril (1865: 478, 479) followed Bleeker and mentioned both *P. dubius* and *P. zijsron* as valid species. However, Günther, (1870: 437) and Day (1878: 729), citing the page numbers in Bleeker (1852a) corrected Bleeker's error and placed *P. dubius* in the synonymy of *P. zijsron*. Both authors only refer to the description of *P. zijsron* in Bleeker 1852a. Apparently, they were not aware of the original description of *P. zijsron* (in Bleeker, 1851b). Recent authors (Whitley, 1940; Bigelow & Schroeder, 1953; Paxton et al., 1989; Compagno, 1986, 1995; Last & Stevens, 1994; Eschmeyer et al., 1996), give the year 1851 for the description of *P. zijsron*. However, only Paxton et al. (1989) and Eschmeyer et al. (1996) refer to the right publication (Bleeker, 1851b), whereas the others refer to Bleeker's "Plagiostomen" paper, which has 1851 on the front page, but was published a year later.

THE PRESENT LOCATION AND EXAMINATION OF SAWFISHES FROM THE BLEEKER COLLECTION

During his stay in Dutch East India, Bleeker likely did not collect many sawfish specimens. Possibly their large size and especially the inflexible rostrum, posed insurmountable storage problems to Bleeker. The saws of nearly all Bleeker specimens are now damaged (bent and/or broken) due to the fact that the specimens were forced in and out of jars that were too small. The specimens deposited in the RMNH collection have now been removed to more ample cylinders.

In 1851, Bleeker's collection of Pristidae consisted of three female specimens of *P. semisagittatus* (two complete, 600 and 700 mm TL; one without the saw, 670 mm), one female specimen (860 mm TL) and a saw of *P. microdon*, one saw of *P. zijsron* and one caudal fin of *P. dubius* (Bleeker, 1852a). In 1852, Bleeker obtained a specimen of *P. zijsron* (Bleeker, 1852b) (900 mm TL). In 1853, a complete female of *P. dubius* (1050 mm TL) was added. In 1855, Bleeker received one more specimen (sex and length not stated) of *P. dubius* collected by D. S. Hoedt from Ambon.

The 900 mm (head and skin) specimen from Badjermassing that was used for the redescription of *P. zijsron* in Bleeker (1852b) apparently was sent to the British Museum, London (now The Natural History Museum). Günther (1870: 437) identified it as *P. perrotteti* [= *perotteti*] Müller & Henle, 1841. Günther considered *P. microdon* a synonym of *P.*

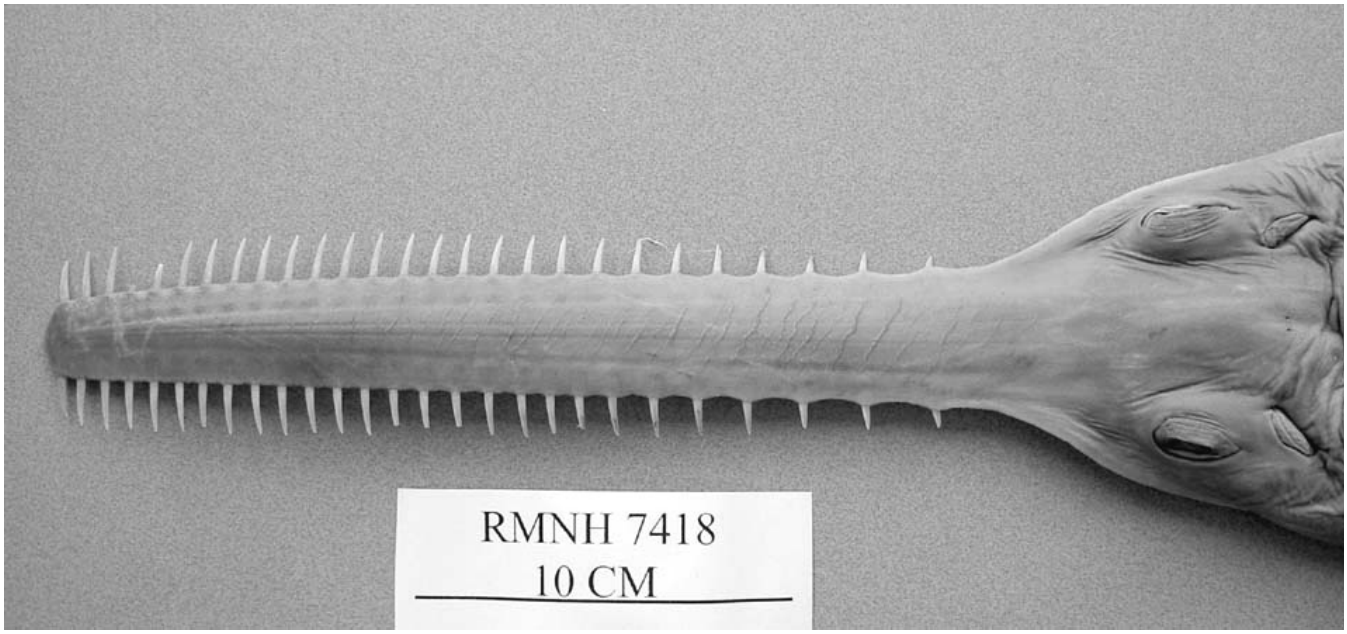

Fig. 7. Saw of RMNH 7418, auction name *Squalus (Pristis) dubius* [= *P. zijsron*], dorsal view.

perotteti. Duméril (1865: 479) and Bertin (1939: 78) mentioned a specimen from Ambon, donated by Bleeker to the Museum Nationale d' Histoire Naturelle in Paris. Dumeril (1865) refers to the specimen as *P. zijsron*, which is correct based on our re-identification of the specimen. Bertin (1939) states that the specimen (MNHN nº 1226) is a paratopotype of *P. dubius.* At variance with the ICZN (1999), Bertin (1939: 64) uses the term paratopotype for specimens from the type series not caught at the type locality. As *P. dubius* was described on the basis of only one specimen, there is only the holotype. According to the MNHN files, this specimen was collected by Bleeker in Ambon in 1856 (Séret, personal communication). Seret & McEachran (1986: 36), who no longer list this specimen among the types, state: "Bertin attribue le statut de << paratopotype >> a ce specimen, or il n'existe qu'un holotype de P. dubius, conservé à Leyden (RMNH nº 7418) (Dingerkus, sous presse)."[Bertin gives this specimen the status of paratopotype while there is only a holotype of *P. dubius*, which is preserved in Leiden (RMNH nº 7418) (Dingerkus, in press).]

For the auction of the Bleeker collection, Hubrecht (1879) divided the collection into 5 series, A to E. Bleeker's sawfishes were placed as follows:

Squalus (*Pristis*) *zysron*	1/ -/ -/ -/ -
Squalus (*Pristis*) *dubius*	1/ -/ -/ -/ -
Squalus (*Pristis*) *semisagittatus*	2/ 1/ -/ -/ -
Squalus (*Pristis*) *microdon*	1/ -/ -/ -/ -

All except one specimen of *Squalus (Pristis) semisagittatus* [=*Anoxypristis cuspidata*] were in the "A series" [the part of Bleeker's collection that was supposed to contain his type specimens (Whitehead et al., 1966)] that was bought by the RMNH, Leiden. The whereabouts of the third specimen of *Squalus (Pristis) semisagittatus* (the female specimen without a saw) are unknown.

RMNH registration numbers and basic data for these specimens are as follows:

Pristis zysron: RMNH 7419, male, [= *P. microdon*], 928 mm TL, 20 pairs of rostral teeth.
Pristis dubius: RMNH 7418, male, [= *P. zijsron*], 1035 mm TL, eviscerated, 27 pairs of rostral teeth.
Pristis semisagittatus: RMNH 7420, female, male, [= *A. cuspidata*], 716 & 782 mm TL, 26/25 & 21/21 rostral teeth.
Pristis microdon: RMNH 7417, female, [= *P. microdon*], 842 mm TL, eviscerated, 18 pairs of rostral teeth.

The type specimens of *P. zijsron* and *P. dubius* are not mentioned in the catalogue. The caudal fin probably remained unnoticed inside the body of the complete specimen of *P. dubius,* but it is remarkable that the saw was not listed as a dry specimen.

The RMNH collection contains one more specimen labelled as *Squalus (Pristis) semisagittatus* [= *A. cuspidata*] collected by Bleeker (RMNH 8003). This specimen was sent to Leiden around 1852 - 1854, as part of a large collection of fishes especially made for the RMNH (see Oijen, 2005: 5). It is remarkable that, apparently, Bleeker did not mention this specimen in any of his papers.

FIGURES OF SAWFISHES PUBLISHED BY BLEEKER AND THE SPECIMENS ON WHICH THEY ARE BASED

Bleeker had drawings of his *Pristis* species prepared for the Atlas Ichthyologique, but they were not published until recently (Bleeker, 1983). The original drawings, which are deposited in the archives of the National Museum of Natural History, Leiden, bear names in pencil (not Bleeker's handwriting). The following species, again placed in the genus *Squalus*, were depicted for the Atlas: *Squalus zijsron* [= *P. microdon*] (Fig. 5A); *S. dubius* [= *P. zijsron*] (Fig. 5B); *S. microdon* [= *P. microdon*] (Fig. 5C) and *S. semisagittatus* [= *Anoxypristis cuspidata*] (Fig. 5D & 5E).

Fig. 8. Saw of RMNH 7417, auction name *Squalus (Pristis) microdon* [= *P. microdon*], dorsal view.

In Bleeker (1983), Figure 2 of Pl. 549 is missing. According to the caption, this figure should have represented "*Squalus cuspidatus* Blkr. (= *Pristis cuspidatus* Lath. cop. ic. Latham)" [= *A. cuspidata*]. On the original plate, a piece of brown paper with an outline paper cutting of a saw of *P. cuspidatus*, was glued on it (Fig. 5F). This outline was copied from a figure in Latham (1794, table 26, Fig. 3). The fact that Bleeker intended to use a copy of a figure of a saw of *S. cuspidatus* from Latham's paper suggests that he had no specimens of this species in his own collection. Descriptions and discussions on each one of the depicted specimens is given below:

Squalus zijsron [= *P. microdon*] (Fig. 5A): As Bleeker only mentions one complete specimen of *Pristis zysron* (Bleeker, 1852b; a saw with head and skin, 900 mm TL) in his papers, it seems that the illustration for the Atlas could only have been made after this specimen. However, the present state of this specimen (BMNH 1867.11.28.185) makes it very unlikely that it was used as a basis for the figure. The specimen in the RMNH collection (RMNH 7419) is a more likely candidate. This male, 893 mm TL, has 20 pairs of rostral teeth, just like the depicted specimen (Fig. 6). The RMNH specimen has longitudinal and transverse lines drawn in India ink on both sides of the saw that may have been used as reference lines by the artist. This specimen is the single specimen of *S. zysron* mentioned in the auction catalogue (Hubrecht, 1879: 54) but is not mentioned in any of Bleeker's papers and it has no geographical origin data.

Squalus dubius [= *P. zijsron*] (Fig. 5B): The figure of *Squalus dubius* [= *P. zijsron* Bleeker, 1851], a male with 27 teeth on each side of the rostrum, should have been based on Bleeker's only complete specimen described as *P. dubius* in 1853 (RMNH 7418, male, 1025 mm TL; Fig. 7). However, the complete specimen mentioned in Bleeker (1853) was described as having 26 or 27 rostral teeth. Therefore, it is not certain that the figured specimen and the described specimen are the same ones.

Squalus microdon [= *P. microdon*] (Fig. 5C): The figure of *Squalus microdon*, a female with 19 teeth on both sides of the rostrum, could be based on Bleeker's only specimen of this species (RMNH 7417; Fig. 8). Like the specimen RMNH 7419, this specimen has ink lines on the anterior part of the head and saw, indicating that it may have been used for the drawing. However, this specimen has 18 pairs of rostral teeth as described by Bleeker (1852a: 54). Therefore, it is not possible to know, if the only existing specimen was in fact depicted in the Atlas.

Squalus semisagittatus [= *A. cuspidata*] (Fig. 5D & 5E): For the habitus figure of *S. semisagittatus* Shaw, Bleeker depicted a specimen without saw and an isolated saw. Whether the saw belongs to the specimen or not is unknown. At least two scenarios are possible: a) the specimen is complete and the artist depicted it separately to save space and allow the specimen to be drawn in more detail or; b) those are two different specimens. If the latter case is true, it is possible that Bleeker used the largest specimen in his collection, the female with the saw cut off. It is not known whether this specimen still exists. And also, the figure of the isolated saw with 25 teeth on the right and 27 on the left would be based on a specimen not mentioned in any of Bleeker's papers. The present location of this specimen is also unknown.

Remarkably, the data on the two specimens of *S. semisagittatus* from the Bleeker collection do not fit the data given in the description. The sizes of the specimens given in Bleeker (1852a) are 600 and 730 mm TL and the number of tooth pairs are 23 and 25 (not necessarily in this order). The Bleeker specimens in RMNH 7420 have total lengths of 716 and 782 mm and 26/25 and 21/21 rostral teeth, respectively. The saw of the smaller specimen is depicted in Figure 9. As the data of the RMNH specimens do not agree with those of the specimens mentioned in Bleeker (1852a), Bleeker must

Fig. 9. Saw of the smaller specimen of RMNH 7420, auction name *Squalus (Pristis) semisagittatus* [= *Anoxypristis cuspidata*], dorsal view.

have removed and replaced his original specimens with the existing ones. Bleeker regularly replaced badly-preserved specimens in his collection with better ones (see Oijen, 2005). However, it is remarkable that the RMNH specimens are not recorded in any of Bleeker's papers.

CONCLUSIONS

The caudal fin, RMNH 34134 is the holotype of *Pristis dubius* Bleeker, 1852. When Bleeker concluded that the saw described as *P. zijsron* in 1851 and the caudal fin on which he based the name *P. dubius* in 1852 were the same species, he should have put *P. dubius* in the synonymy of *P. zijsron* as the latter has priority over the former. However, Bleeker did the opposite and created another problem by designating two specimens for the name, *P. zijsron.* As the second name bearing specimen is now identified as belonging to *P. microdon*, this problem is resolved.

Bleeker published relatively few papers on Pristidae, in light of his total number of publications on fishes (at least 500). He only collected juvenile sawfish specimens and he never seems to have examined specimens that were too large to be preserved in his collection. Not all specimens from Bleeker's collection were mentioned in his publications and some of the specimens mentioned cannot be recovered in present collections. As a result, there are certain inexplicable discrepancies between the descriptions, figures and the data of existing specimens from the Bleeker collection.

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LITERATURE CITED

Bigelow, H. B. & W. C. Schroeder, 1953. Sawfishes, guitarfishes, skates and rays. In: Parr, A. E. (ed.) Fishes of the western North Atlantic. *Memoir Sears Foundation for Marine Research,* **1**(2): 1-514.

Bertin, L., 1939. Cataloque des types de Poissons du Muséum National d'Histoire Naturelle. 1ere Partie. Cyclostomes et sélaciens. *Bulletin du Mueum. National d'Histoire naturelle* 2e série, **11**(1): 51-98. (In French).

Bleeker, P., 1851a. Bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van 16 nieuwe soorten van zoetwatervisschen. *Natuurkundig Tijdschrchrift voor Nederlndsch Indië,* **I**: 1-16. (In Dutch).

Bleeker, P., 1851b. Vijfde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. *Natuurkundig Tijdschrchrift voor Nederlandsch Indië,* **II**: 415-442. (In Dutch).

Bleeker, P., 1852a. Bijdragen tot de kennis der Plagiostomen van den Indischen Archipel. *Verhandelingen Bataafs Genootschap,* **XXIV**(12):1-90. Aanhangsel pp 91-92, 4 pls. (In Dutch).

Bleeker, P., 1852b. Zesde bijdrage tot de kennis der ichthyologische fauna van Borneo. Vissen van Pamangkat, Bandjermassing, Praboekarta en Sampit. *Natuurkundig Tijdschrift voor Nederlndsch Indië,* **III**: 407-442. (In Dutch).

Bleeker, P., 1853. Zevende bijdrage tot de kennis der ichthyologische fauna van Borneo. Zoetwatervissen van Sambas, Pontianak en Pangaron. *Natuurkundig Tijdschrift voor Nederlndsch Indië,* **V**: 427-462. (In Dutch).

Bleeker, P., 1855. Zesde bijdrage tot de kennis der ichthyologische fauna van Amboina. *Natuurkundig Tijdschrift voor Nederlndsch Indië,* **VIII**: 391-434. (In Dutch).

Bleeker, P., 1856a. Achtste bijdrage tot de kennis der vischfauna van Amboina. *Acta Societatis Scientiarum Indo-Neerlandicae,* **II**: 1-102. (In Dutch).

Bleeker, P., 1856b. *Reis door de Minahassa en den Molukschen archipel. Gedaan in den maanden september en oktober 1855 in het gevolg van den gouverneur Mr. A. J. Duymaer van Twist.* Lange & Co., Batavia, Pp. 1-364, pls. i-xvi. (In Dutch).

Bleeker, P., 1860. Dertiende bijdrage tot de kennis van de vischfauna van Borneo. *Acta Societatis Scientiarum Indo-Neerlandicae*, **VII**: 1-12. (In Dutch).

Bleeker, P., 1861. Iets over de vischfauna va het eiland Pinang. *Verslagen en Mededelingen der Koninklijke Akademie van Wetenschappen,* **XII**: 64-80. (In Dutch).

Bleeker, P., 1865. Enumération des espèces de poisons actuellement connues de l'ile d'Amboine. *Nederlansch Tijdschift voor de Dierkunde*, **II**: 270-293. (In Dutch).

Bleeker, P., 1869. Unpublished MS. Specierum Piscium hucusque in Archipellago Indico observatorum Enummeratio nova revisa. (In Dutch).

Bleeker, P., 1873. Mémoire sur la faune ichthyologique de Chine. *Nederlansch Tijdschift voor de Dierkunde*, **IV**: 113-154. (In Dutch).

Bleeker, P., 1875. *Recherches sur la faune de Madagascar et de ses dépendances d' apres les découvertes de François P.L. Pollen et D.C. van Dam. 4e Partie. Poissons de Madagascar et de l'ile de la Réunion.* Leiden. Pp. 1-89, pls. 21. (In French).

Bleeker, P., 1877. Unpublished MS. Specierum Piscium hucusque in Archipellago Indico observatorum Enummeratio nova revisa. Plane revidenda 1877. (In Latin).

Bleeker, P., 1878. Petri Bleeker Scriptorum Ichthyologicorum husque in lucem enumeratio chronologica. In: Bleeker, P. (ed.), *Levensbericht van Pieter Bleeker.* Jaarboek van de Koninklijke Nederlandsche Akademie van Wetenschappen. Pp. 56-99.(In Latin).

Bleeker, P., 1983. *Atlas Ichthyologique des Indes Orientales Néêrlandaises. Plates prepared for Tomes XI-XIV*. Smithsonian Institution Press, Washington. Pp. 1-22, pls. 421-575.

Compagno, L. J. V., 1986. Various elasmobranch families. In: Smith, J. L. B. & P. C. Heemstra. (eds.), *Smiths' Sea Fishes.* Macmillian, Johannesburg. Pp. 1-1024, pls. i-xx.

Compagno, L. J. V., 1995. Order Pristiformes. In: Smith, J. L. B. & P. C. Heemstra. (eds.), *Smiths' Sea Fishes*. Third impression. Macmillian, Johannesburg. Pp. 1-1047, pls. i-xxxi.

Day, F., 1878. *The Fishes of India; being a natural history of the fishes known to inhabit the seas and fresh waters of India, Burma, and Ceylon. Part 4*. Bernard Quaritch, London. Pp. i-xx + 553-779. Pls 139- 195.

Duméril, A. H. A., 1865. *Histoire naturelle des Poissons ou Ichthyologie Générale. Tome Premier, Elasmobranches,* Plagiostomes et Holocephales ou Chimères*.* Paris. 720 pp. (In French).

Eschmeyer et al., 1996. *Catalogue of Fishes, Vol. II. Species of Fishes* (M-Z). California Academy of Sciences, California. Pp 959-1820.

Faria, V. V. & M. McDavitt. Taxonomic review of the Sawfishes (Chondrichtyes, Pristidae). In preparation.

Günther, A., 1870. *Catalogue of the Fishes of the British Museum*. VIII. Trustees of the British Museum, London. Pp. 1-549, pls. i-xxv.

Hubrecht, A. A. W., 1879. *Catalogue des collections formées et laissées par M. P. Bleeker*. De Breuk & Smits, Leiden. Pp. 1-71, pls. i-iv. (In French).

International Commission on Zoological Nomenclature, 1999. *International Code of Zoological Nomenclature, Fourth edition.* London. 306 pp.

Lamme, W. H. (ed.), 1975. *Collected fish papers of Pieter Bleeker, Vol III*. Junk Publishers, The Hague, The Netherlands.

Last, P. R. & J. D. Stevens, 1994. *Sharks and Rays of Australia.* CSIRO, Australia. Pp. i-v + 1-513, pls. 1-84.

Latham, J., 1794. An essay on the various species of sawfish. *Transactions of the Linnean Society of London,* **2**: 273-282.

Müller, J. & J. Henle, 1841. *Systematische Beschreibung der Plagiostomen*. Von Voit und Co., Berlin. 200 pp. (In German).

Oijen, M. J. P. van, 2005. Data on the genesis of the Atlas Ichthyologique from a little known French paper by P. Bleeker. *Raffles Bulletin of Zoology, Supplement*, **13**: 3-8.

Paxton, J. R., D. F. Hoese, G. R. Allen & J. E. Hanley, 1989. *Zoological Catalogue of Australia. Vol. 7, Pisces*. CSIRO Publishing, Canberra. Pp. 1- 665, pls. i-vii.

Shaw, G., 1804. *General zoology or systematic natural history. Pisces Volume 5, part 1*. G. Kearsley, London. Pp. 1-463, pls. i-x.

Sèret, B. & J. D. McEachran, 1986. Catalogeu critique des types de poisons du Museum national d'Histoire naturelle. (Suite.) Poissons Batoïdes (Chondrichthyes, Elasmobranchii, Batoidea). *Bulletin du Museum. National d'Histoire naturelle*, 4^{e} série **8**(4): 3-50. (In French).

Whitehead, P. J. W., M. Boeseman & A. Wheeler, 1966. The types of Bleeker's Indo-Pacific elopoid and clupeoid fishes. *Zoologische Verhandelingen Leiden*, **84**: 1-152.

Whitley, G.P., 1940. *The Fishes of Australia. Part 1. The Sharks, Rays, Devil-Fish and other Primitive fishes of Australia and New Zealand.* Royal Zoological Society of New South Wales, Sydney. 280 pp.