# The genus Vates Burmeister, 1838, in French Guiana, with the description of two new species (Mantodea, Mantidae, Vatinae) 

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https://zoobank.org/References/8677B212-2BC8-4BBB-ACF1-ADD0DBE691BB
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#### Abstract

Vates marmorata n. sp. and Vates patrinata n. sp. (Mantidae, Vatinae) are described from French Guiana. The new species are close to V. biplagiata and V. festae, all exhibiting strong tubercles along pronotal margins but differing in male genital structures. Description, images, and measurements of anatomical parts are presented, along with distributional, natural history, and DNA barcoding data. A key to species of Vates known in French Guiana is formulated. This study highlights the value of DNA barcoding in disclosing hidden diversity in Mantodea, especially when coupled with traditional taxonomic tools. Résumé. - Le genre Vates Burmeister, 1838, en Guyane, avec la description de deux nouvelles espèces (Mantodea, Mantidae, Vatinae). Vates marmorata n. sp. et Vates patrinata n. sp. (Mantidae, Vatinae) sont décrites de Guyane. Ces nouvelles espèces sont proches de V. biplagiata et V. festae, toutes présentant de forts tubercules le long des marges du pronotum, mais se distinguant par les structures génitales mâles. La description, les images et les mesures des parties anatomiques sont présentées, ainsi que les données de répartition, d'écologie et de code-barre ADN. Une clé des espèces de Vates connues de Guyane est proposée. Cette étude met en évidence la valeur du code-barres ADN pour révéler la diversité cachée des Mantodea, en particulier lorsqu'il est associé à des outils taxonomiques traditionnels.


Keywords. - South America, Mantodea, morphology, barcoding, taxonomy.

The genus Vates Burmeister, 1838, currently contains 13 species: V. amazonica (Westwood, 1889), V. biplagiata Sjöstedt, 1930, V. boliviana Giglio-Tos, 1914, V. chopardi DeelemanReinhold, 1957, V. festae Giglio-Tos, 1914, V. foliata (Lichtenstein, 1802), V. lobata (Fabricius, 1798), V. luxuriosa Beier, 1958, V. pectinata Saussure, 1871, V. pectinicornis (Stål, 1877), V. phoenix Rivera, Herculano, Lanna, Cavalcante \& Teixeira, 2020, V. serraticornis (Stål, 1877) and V. weyrauchi Beier, 1958 (Отte et al., 2022).

Recently, studies on the classification of the Vatinae subfamily have made it possible to clarify the status of the genus Vates (Svenson et al., 2016; Schwarz \& Roy, 2019), unfortunately without producing a dichotomous key. The last key grouping most species dates from 1958 (Beier, 1958). It is therefore necessary to gather all publications citing Vates genus to find your way around (Rehn, 1911; Giglio-Tos, 1927; Hebard, 1933; Lombardo \& Agabiti, 2001; Ehrmann, 2002; Svenson et al., 2016; Rivera et al., 2020).

Taking the known data for French Guiana, a synthesis was able to emerge (Moulin \& Roy, 2020). At the time, the identification of the various examined specimens of Vates was not questioned enough. Four species had been identified: V. amazonica, V. biplagiata, V. lobata, and $V$. luxuriosa. However, the known geographical distributions for these species did not correspond with current identifications of Vates specimens collected in French Guiana. To clarify the identity of the French Guiana Vates, thirty specimens have been subjected to DNA barcoding.

## Material and methods

Examined specimens were either collected in the field or borrowed from Museum depository. I examined a total of 97 adult specimens from 32 localities within French Guiana: Angoulême, Apatou, Cayenne pk10, Centre spatial, crique Canceler, degrad Corrèze, Kaw, Macouria RN1 pk19, Matiti, Maya, Mitaraka, montagne de Fer, montagne des Chevaux, mont Chauve, Monsinery pk5, mont Saint-Marcel, mont Tabulaire, Nouragues, Papaïchton, Petit-Saut, piste Coralie, piste Denis, piton rocheux d'Armontabo, plateau Serpent, Régina RN2 pk119, Réserve Naturelle Nationale de la Trinité, Saint-Laurent-du-Maroni, Saül, Saut-Dalles, savane des Pères, savane Lambert, Trou-Poissons. The distribution map was made using QGIS software 3.8 Zanzibar. The administrative area is from http://www.diva-gis.org.

The methods used for field collections consisted mainly of attraction by light ( 250 W mixed mercury vapor bulb with a white sheet or automatic light trap with a Polytrap ${ }^{\mathrm{TM}}$ ) or hand catching (night and day) (Touroult et al., 2018; Roy, 2019; Moulin \& Roy, 2020). Some females and males were pinned after genitalia preparation was made (males) and a leg was preserved in ethanol for DNA barcoding with tissue samples deposited in CCDB in Guelph.

Morphological nomenclature, specimen preparation and genital dissection procedures followed Brannoch et al. (2017). Specimens were measured using a Leica S8APO stereomicroscope connected to a Leica MC120 HD camera. All measurements in this study were taken with a caliper and are expressed in millimetres. A total of 21 measurement classes were captured, as in Tedrow et al. (2014) and Rivera et al. (2020).

1. Body length $=$ length of body from central ocelli to posterior tip of abdomen (intraspecifically variable measurement, primarily for general size estimation).
2. Forewings length $=$ from proximal margin of axillary sclerites to distal tip of the discoidal region.
3. Hindwings length $=$ from proximal margin of axillary sclerites to distal tip of the discoidal region.
4. Pronotum length $=$ from anterior margin to posterior margin.
5. Prozone length $=$ anterior margin of pronotum to center of supra-coxal sulcus.
6. Pronotum width $=$ from the lateral margins at the widest point, the supra-coxal bulge.
7. Pronotum ratio $=$ ratio between pronotum width and length.
8. Pronotum shape $=$ ratio metazone to prozone.
9. Pronotum posterior margin width $=$ from lateral margins of the pronotum at the posterior margin of metazone.
10. Head width $=$ from lateral margins of the eyes at the widest point.
11. Frons width $=$ from lateral margins of the frons, inferior to the antennal insertions, at the widest point.
12. Frons height = from upper margin abutting central ocellus to lower margin abutting clypeus.
13. Forecoxae length $=$ from pronotum to trochanter.
14. Forefemora length $=$ from proximal margin abutting trochanter to distal margin of genicular lobe.
15. Mesofemora length = from most proximal margin abutting the trochanter to the distal side of the terminal spine insertion site.
16. Mesotibiae length = from most proximal groove near joint with the femur to the distal side of the terminal spine insertion site.
17. Metafemora length = from most proximal margin abutting the trochanter to the distal side of the terminal spine insertion side.
18. Metatibiae length = from most proximal groove near femoral joint to the distal side of the terminal spine insertion site.
19. Anteroventral femoral spine count $=$ all inner marginal ridge spines, except the distal terminal spur.
20. Anteroventral tibial spine count = all inner marginal ridge spines, except the distal terminal spur.
21. Posteroventral tibial spine count $=$ all outer marginal ridge spines but except the distal terminal spur.
The measurement of the total body length produces a measurement only useful for general assessment of body size rather than species description. Since head position, abdominal expansion, and wing position are all variable, total body length should only be used as a rough measurement to initially discriminate between the small and large Mantodea species when performing identifications.

Alive specimen of Vates patrinata n. sp. were photographed with a Nikon E 4800 by Antoine Lévêque on 2008, October $30^{\text {th }}$, at the RNN Trinité and alive specimen of Vates marmorata n. sp. were photographed with a Konica-Minolta Dynax 5D by author on 2018, November, at Papaïchton in French Guiana. Habitus images were taken with a Konica-Minolta Dynax 5D. All images were taken over an $18 \%$ grey card background for white balance standards. Images were processed in GIMP 2 to adjust levels, contrast, exposure, sharpness, and to add scale bars. Minor adjustments were made using the stamp tool to correct background aberrations and to remove distracting debris. Plates were constructing using Publisher 2016.

DNA barcoding, the analysis of a standardized segment of the mitochondrial cytochrome c oxidase subunit $\mathrm{I}(\mathrm{COI})$ gene, was performed on a representative selection of specimens $(\mathrm{n}=30)$. Tissues were sent to CCDB at the University of Guelph for DNA extraction, polymerase chain reaction (PCR), and sequencing. DNA was extracted from dry legs using a routine silica-based 96 -well extraction automation protocol (Ivanova et al., 2006). The 658 base pairs region of COI proposed for use as a 'DNA barcode' (Hebert et al., 2003) was amplified with the PCR primers C_LepFolF/C_LepFolR (Hebert et al., 2004). Data are currently managed under the following project: "DNA Barcoding Mantodea - Collection N. Moulin" Barcode of Life Data Systems (BOLD, Biodiversity Institute of Ontario, Canada; http://www.boldsystems.org). Kimura-2-parameter (K2P) distances were calculated using the BOLD 4.0 interface (Ratnasingham \& Hebert, 2007). COI sequences were then analysed using the Maximum Likelihood method with 2000 bootstrap replicates, and trees constructed using MEGA X (Kumar et al., 2018).

Specimens examined are deposited at the Muséum national d'Histoire naturelle (Paris, France) and in the Research Collection of Nicolas Moulin (Montérolier, France).


#### Abstract

Abbreviations. - ASPER, Association pour la Systématique des Phasmes et l'Étude de leur Répartition, Sainte-Foy-d'Aigrefeuille, France; BOLD, Barcode of Life Project, Biodiversity Institute of Ontario, Guelph, Canada; CNRS, Centre National de la Recherche Scientifique; CUV, Canopy Ultra-Violet; CVB, Canopy trap with Blue lumiVie; INPN, Inventaire national du Patrimoine naturel; MNHN, Muséum national d'Histoire naturelle, Paris, France; OFB, Office Français de la Biodiversité; PGL, Automatic light trap Gemlight ${ }^{\circledR}$ with one UV LED and one green LED; PNI, Pro-Natura International NGO; PVB, Automatic light trap Blue Led; PVP, Automatic light trap Pink Led; RCNM, Research Collection of Nicolas Moulin, Montérolier, France; RNN, Réserve Naturelle Nationale; SEAG, Société Entomologique Antilles-Guyane.


## Results <br> Mantodea, Mantoidea, Mantidae, Vatinae, Vatini, Vatina

Genus Vates Burmeister, 1838
The following characters led to place the new species within the genus Vates: males with pectinate antennae; mesotibiae with two median lobes; ocellar tubercle cuticle above lateral ocelli forming contiguous or divergent conical projections; male genitalia with posterior process (pda) of the ventral left sclerite (L4A) acuminate or 'scimitar-like' (Svenson et al., 2016; Rivera et al., 2020).

## Vates marmorata n. sp.

https://zoobank.org/NomenclaturalActs/CEED1CF1-62D0-4D17-B9ED-5FFF9F452ACA
Holotype: $\delta^{\lambda}$ pinned (fig. 1-2), French Guiana, Papaïchton, path in clear forest, GF18-01, light trap, $-54.1189,3.8152$, alt. $200 \mathrm{~m}, 3 . X I .2018$, BOLD GFMAN18-100, Genitalia prep. NM0219, MNHN-EP7505, leg. N. Moulin [MNHN].

Allotype: + pinned (fig. 3-4), French Guiana, Papaïchton, path in clear forest, GF18-03, light trap, $-54.1189,3.8152$, alt. $200 \mathrm{~m}, 5 . \mathrm{XI} .2018$, BOLD GFMAN18-139, MNHN-EP7506, leg. N. Moulin [MNHN].

Paratypes ( $2 \delta^{\lambda}$ ): $1 \delta^{\lambda}$, French Guiana, Papaïchton, path in clear forest, GF18-05, light trap, -54.1189, 3.8152, alt. $200 \mathrm{~m}, 7 . \mathrm{XI} .2018$, BOLD GFMAN18-143, MNHN-EP7507, leg. N. Moulin [MNHN]; 1 §̋, idem, BOLD GFMAN18-147, leg. N. Moulin [RCNM].

Other material examined. - 12 万, French Guiana: 2 万, Macouria, RN1, pk19, light trap, 28.II.1997, leg. A. François [MNHN]; 2 §', Iracoubo, ‘Trou-Poissons', PVB, -53.088076, 5.431518, alt. $7 \mathrm{~m}, 7 . \mathrm{V} .2014$, leg. SEAG team [MNHN]; 2 §', Kourou, 'savane des Pères', light trap, -52.659108, 5.123710 , alt. $5 \mathrm{~m}, 26 . \mathrm{VII} .2014$, leg. SEAG team [MNHN]; 1 §', Maripasoula, Mitaraka, crique Alama, Drop Zone, "Our Planet Reviewed" 2015, MNHN/PNI Guyane (APA-973-1), -54.513666, 2.298966, alt. 300 m , 25.II-26.III.2015, leg. E. Poirier, J. Touroult, P.-H. Dalens, S. Hugel, F. Legendre [MNHN];


Fig. 1-2. - Vates marmorata n. sp., o' holotype MNHN EP7505, habitus. - 1, Dorsal view. - 2, Ventral view.


Fig. 3-4. - Vates marmorata n. sp., $q$ allotype MNHN EP7506, habitus. - 3, Dorsal view. - 4, Ventral view.

1 万, Macouria, coastal forest Maya, PVB, -52.460277, 4.955277, alt. $30 \mathrm{~m}, 12 . \mathrm{XII} .2015$, leg. SEAG team [MNHN]; 2 §, Saül, 'point de vue', PVB, -53.207415, 3.593144, alt. 220 m, 21.I-9.III.2016, leg. SEAG team [MNHN]; 1 §, Montsinéry-Tonnegrande, 'savane Lambert', PVP, -52.518888, 4.888055, alt. 8 m , leg. SEAG team [MNHN]; 1 §, Sinnamary, 'crique Canceler', light trap, $-53.038083,5.4298386$, alt. $12 \mathrm{~m}, 8 . \mathrm{XII} .2021$, Genitalia prep. NM0220, leg. J. Lapèze [RCNM].

Diagnosis. - Vates marmorata n. sp. is morphologically very close to V. biplagiata (fig. 45). Females differ from V. biplagiata in forewings brownish with brown marbling (forewings greenish in $V$. biplagiata) and pronotum slightly shorter (pronotum length: V. biplagiata $=$ 23.2 mm ; V. marmorata n. sp. $=21.0 \mathrm{~mm}$ ) and less robust (fig. 3, 13-17, 45).

Males differ from other species in Vates genus by genitalia morphology, with a longer and thinner apa than $V$. festae and $V$. biplagiata; a sdpl (lateral secondary distal process) thicker at its base and the tip very slightly more curved than V. biplagiata (fig. 11-12). Males differ from $V$. festae by S-shaped antennomeres (straight comb antennomeres in $V$. festae) and differ from $V$. biplagiata by thinner pronotum (pronotum width/length ratio: V. biplagiata $=0.26$; V. marmorata $\mathrm{n} . \mathrm{sp} .=0.24$ ) and presence of two very discrete brown spots around the stigma on forewings (fig. 8).

Description of male. - Fig. 1-2, 5-12, 40, 45, table I.
Head. Eyes rounded. Vertex flat, higher than imaginary line connecting dorsal margin of compound eyes. Juxtaocular bulges flat, aligned to vertex. Ocellar tubercles bearing two well-developed conical

Table I. - Vates marmorata n. sp., measurements of types and non-types adult females and males.

|  | § holotype [MNHN] | q allotype [MNHN] | $\lesssim$ average (range) from 16 specimens * | average (range) from 5 specimens * |
| :---: | :---: | :---: | :---: | :---: |
| 1. Body length | 47.4 | 53.2 | 46.5 (43.5-48.6) | 52.1 (50.4-53.6) |
| 2. Forewings length | 35.3 | 36.5 | 33.3 (30.1-36.1) | 37.9 (36.5-39.3) |
| 3. Hindwings length | 31.9 | 33.8 | 31.1 (28.6-32.8) | 33.5 (33.1-33.8) |
| 4. Pronotum length | 17.6 | 21.0 | 16.8 (15.2.-17.9) | 20.7 (20.3-21.0) |
| 5. Prozona length | 3.6 | 4.4 | 3.5 (2.8-3.8) | 4.4 (4.2-4.5) |
| 6. Pronotum width | 4.7 | 5.5 | 4.2 (3.6-4.7) | 5.4 (5.3-5.5) |
| 7. Pronotum width/length [ratio] | 0.27 | 0.26 | 0.25 (0.23-0.27) | 0.26 (0.26-0.27) |
| 8. Pronotum posterior margin width | 2.4 | 3.2 | 2.5 (2.2-2.7) | 3.1 (2.9-3.2) |
| 9. Head width | 6.1 | 7.0 | 5.9 (5.5-6.1) | 6.9 (6.5-7.1) |
| 10. Frons width | 1.8 | 2.4 | 1.7 (1.6-1.9) | 2.4 (2.3-2.4) |
| 11. Frons height | 0.7 | 0.9 | 0.6 (0.5-0.7) | 0.8 (0.8-0.9) |
| 12. Forecoxae length | 9.2 | 12.1 | 9.3 (8.5-9.7) | 11.5 (11-12.1) |
| 13. Forefemora length | 11.1 | 13.6 | 11.0 (10.4-11.7) | 13.5 (13-13.8) |
| 14. Mesofemora length | 9.8 | 11.1 | 9.5 (8.9-9.8) | 11.0 (10.5-11.6) |
| 15. Mesotibiae length | 7.7 | 8.9 | 7.5 (7.0-8.0) | 8.7 (8.4-8.9) |
| 16. Metafemora length | 12.2 | 13.8 | 11.7 (10.9-12.5) | 13.4 (12.6-13.8) |
| 17. Metatibiae length | 10.2 | 11.9 | 9.8 (8.8-10.5) | 11.6 (11.3-11.9) |
| 18. Anteroventral femoral spine [count] | 15 | 15 | 13-15 | 14-15 |
| 19. Anteroventral tibial spine [count] | 15 | 14 | 13-15 | 14-16 |
| 20. Posteroventral tibial spine [count] | 10 | 11 | 10-12 | 11-12 |

[^0]projections, well-spaced at the apex. Central ocellus rounded, lateral ocelli elliptical. Antennae with scape, pedicel and first antennomere light brown, rest of antenna brown, proximal-most antennomeres cylindrical, rest S-shaped, conferring antennae with a pectiniform appearance, distal-most antennomeres more or less filiform. Lower frons sub-pentagonal, wider than high, smooth, with two dark little area under the scape base, upper margin arcuate, and concave. Maxillary palps light brown except the two first


Fig. 5-8. - Vates marmorata n. sp., male morphology, holotype MNHN EP7505. - 5, Head, frontal view. - 6, Details on ocellar tubercules process, frontal view. - 7, Forecoxae, ventral view. - 8, Forewings, details on costal area, dorsal view.
segments, the base of the third one, and the last one, dark brown; inner margin of labial palps darkened, upper margin light brown.

Thorax. Pronotum elongated, metazona triangular in cross-section. Supracoxal dilatation moderately pronounced and broadly rounded; ratio metazona/prozona $=3.89$ (holotype) (variation across male paratypes 4.06-4.43). Distal margin of prozona uniformly curved, margins with spaced out, blunt tubercles; metazona with large dark tubercles. Dorsal surface of metazona keeled along its midline (keel more pronounced proximally). Pronotum predominantly light brown, and a little black diffuse area at the height of the enlargement of the supracoxal dilatation.

Prothoracic legs. Coxae triangular in cross-section, ventral margin pale yellowish, except for a small and distally positioned dark spot on its anterior aspect, and a larger preapical spot posteriorly, just before forecoxal lobes; dorsal margin bearing four spine-like, darkened tubercles interleaved with smaller, paler ones; dorsal side of forecoxae brown with two paler bands and scattered small, dark and paler tubercles. Spination formula: $F=4 D S / 15 \mathrm{AvS} / 4 \mathrm{PvS} ; \mathrm{T}=15 \mathrm{AvS} / 10 \mathrm{PvS}$ (holotype); $\mathrm{F}=4 \mathrm{DS} / 13-$ $15 \mathrm{AvS} / 4 \mathrm{PvS} ; \mathrm{T}=13-15 \mathrm{AvS} / 10-12 \mathrm{PvS}$ (other specimens). Ventral side of forefemora light brown, threebanded; dorsal margin slightly sinuous; discoidal spines I, II and III mostly pale with darkened apex, spine IV entirely black; anteroventral spines II, IV, VI, VIII, X, XII and XIV entirely dark, spine XIV larger than the others; remaining spines smaller, pale at the base, and with darkened apex; spine size arrangement: ililiiiliIiIiiI; genicular spurs developed and present on both sides of femora; tibial spur groove located almost in middle of femora. Foretibiae light brown, dorsally three-banded.

Wings. Forewings surpassing abdomen by $1 / 4$ of their length in resting position, with membrane of costal area opaque and predominantly green (yellow: discoloured by conservation), with a whitish longitudinal strip along margin of costal vein, distal-most portion of costal vein and membrane around radial vein darkened; discoidal area entirely hyaline with yellowish longitudinal veins, apex very slightly darkened, with more densely reticulate venation; stigma of very light colour, surrounded in front by a small diffuse brownish spot, behind by a spot also diffuse and brownish but larger, fairly well distinguishable. Anal area small, veins whitish. Hindwings hyaline and colourless, yellowish longitudinal veins, apex of discoidal area densely reticulated and dark brown; anal area largely hyaline, veins whitish.


Fig. 9-10. - Vates marmorata n. sp., male morphology, holotype MNHN EP7505. - 9, Mesothoracic legs, dorsal view. 10, Metathoracic legs, dorsal view.

Meso- and metathoracic legs. Mesofemora with a posteroventral keel forming two evident lobes: a well-produced, rounded proximal one, and an also well-produced pre-apical one, shaped like an elongated dorsal fin; with an anteroventral keel forming a very slightly pre-apical lobe. Metafemora with a marked posteroventral keel forming a pre-apical lobe shaped like a shark's dorsal fin; with an anteroventral keel forming a little, elongated and obtuse pre-apical lobe. Mesotibiae with two produced medial lobes, shaped like shark's dorsal fin; and two apical lobes, an elongated but scarcely produced anterodorsal one, and an almost equally produced anteroventral one. Metatibiae with two produced medial lobes, also shaped like shark's dorsal fin, but posteroventral one more rounded; and two elongated less produced apical lobes.

Abdomen. Slightly compressed dorsoventrally, widest between III-V, brownish. Supraanal plate triangular in shape, wider than longer, rounded. Cerci cylindrical and elongated, not surpassing apex of subgenital plate, last cercomere conical.

Genitalia. Left phallomere: with sclerite L4B longer than wide, its left margin projects anteriorly; anterior process (afa) glabrous, sinuous, basal half broad but tapering distally, very elongated, apex more


Fig. 11-12. - Vates marmorata n. sp., male genital structures, holotype MNHN EP7505. - 11, Ventral view. - 12, Dorsal view. [afa: anterior process (left phallomere); an: anterior apodeme; $b m$ : dextral extension; fda: main posterior lobe (with R1 sclerotization); $L 4 A$ : sclerite extending over the ventral wall (ventral phallomere); $L 4 B$ : sclerite extending over the dorsal wall (left phallomere); loa: posteromesal lobe (left phallomere); paa: posterior process (left phallomere); pda: posterior process (ventral phallomere); pia: process posterolateral to pva (right phallomere); $p v a$ : process anteromesal to pia (right phallomere); $R 3$ : anteriorly extending sclerite (right phallomere); $s d p l$ : lateral secondary distal process].
strongly sclerotized, with sharp, pointy apex; posteromesal lobe (loa) elongated and sinuous, glabrous, lacking projections; posterior process (paa) elongated, curved. Ventral phallomere: sclerite L4A roughly rectangular, proximal left margin slightly sinuous and more slerotized; lateral secondary process (sdpl) elongated, stocky, and apex strongly sclerotized and tapering distally, uniformly curved right. Right phallomere: roughly triangular, distal margin folded anteriorly; anterior apodeme (an) of sclerite R3 elongated, distally broadened, main posterior lobe (fda) with a relatively broad dextral extension (bm); process anteromesal to pia (pva) curved ventrally, strongly sclerotized, with an elongated and rounded apex; process posterolateral to pva (pia) rectangular, and well sclerotized.

## Description of female. - Fig. 3-4, 13-17, 41, 45, table I.

Head. Eyes rounded. Vertex flat, higher than imaginary line connecting dorsal margin of compound eyes. Parietal suture darkened, juxtaocular bulges flat and aligned to vertex. Ocellar tubercles bearing two conical projections tapering at the apex and diverging. Ocelli rounded, lateral ocelli twice as large as central ocellus. Antennae filiform, scape and pedicel light brown, flagellomeres dark brown. Lower frons sub-pentagonal, wider than high, smooth, medially darkened, upper margin arcuate, smooth and concave, with two dark little area under the scape base. Maxillary palps light brown except the two first segments, $2 / 3$ of the third, and the underside of the last one, dark brown; inner margin of labial palps darkened, upper margin light brown.

Pronotum elongated, metazona triangular in cross-section. Supracoxal dilatation moderately pronounced and broadly rounded; ratio metazona/prozona $=3.77$ (allotype) (variation across female specimens 3.53-3.83). Distal margin of prozona uniformly curved, margins with small, spaced out, blunt tubercles, also along margins of supracoxal dilatation; metazona with large dark tubercles decreasing in density proximally. Dorsal surface of metazona keeled along its midline (keel more pronounced proximally). Pronotum predominantly light brown, with little spots (sometimes with a small tubercle on the prozona) and a light brown area at the height of the enlargement of the supracoxal dilatation.

Prothoracic legs. Coxae triangular in cross-section, ventral margin pale yellowish brown, except for a small and distally positioned dark spot on its anterior aspect, and a larger preapical spot posteriorly, just before forecoxal lobes; dorsal margin bearing four to five spine-like, darkened tubercles interleaved with smaller, paler ones; dorsal side of forecoxae brown with two paler bands and scattered small, dark and paler tubercles. Spination formula: $\mathrm{F}=4 \mathrm{DS} / 15 \mathrm{AvS} / 4 \mathrm{PvS} ; \mathrm{T}=14 \mathrm{AvS} / 11 \mathrm{PvS}$ (allotype); $\mathrm{F}=4 \mathrm{DS} / 14-$ $15 \mathrm{AvS} / 4 \mathrm{PvS} ; \mathrm{T}=14-16 \mathrm{AvS} / 11-12 \mathrm{PvS}$ (other specimens). Ventral side of forefemora light brown, threebanded, with a small light brown spot near trochanter; dorsal margin slightly sinuous; discoidal spines I, II and III mostly pale with darkened apex, spine IV entirely dark; anteroventral spines IV, VI, VIII, X, XII and XV entirely dark, spine XV larger than the others; remaining spines smaller, pale, slightly green at the base and with darkened apex; spine size arrangement: iiiiiiiiiiiiIiil; genicular spurs developed and present on both sides of femora; tibial spur groove located in middle of femora. Foretibiae light brown, dorsally three-banded.

Wings. Forewings surpassing abdomen by $1 / 4$ of their length in resting position, with membrane of costal area opaque and predominantly green (yellow when discoloration cause of conservation), with some brown marbling. A whitish longitudinal strip, with a thin brown border, along margin of costal vein, distal-most portion of costal vein and membrane around radial vein darkened; discoidal area hyaline with brown marbling; stigma of very light colour, surrounded by two diffuse brownish spots. Anal area small, veins greenish. Hindwings hyaline and colourless, costal area and longitudinal veins greenish, apex of discoidal area densely reticulated and dark brown; anal area largely hyaline, veins whitish to greenish.

Meso- and metathoracic legs. Mesofemora with a posteroventral keel forming two evident lobes: a well-produced, rounded proximal one, and an also well-produced pre-apical one shaped like an elongated dorsal fin; with an anteroventral keel forming a scarcely produced pre-apical lobe. Metafemora with a marked posteroventral keel forming a single pre-apical lobe, also shaped like a shark's dorsal fin; with an anteroventral keel forming an elongated, triangular pre-apical lobe. Mesotibiae with two produced medial lobes, shaped like shark's dorsal fin; and two apical lobes, an elongated but scarcely produced anterodorsal one, and an almost equally produced but triangular anteroventral one. Metatibiae with two produced medial lobes, also shaped like shark's dorsal fin, but posteroventral one more rounded; and two elongated and less produced apical lobes.

Abdomen fusiform, slightly flattened dorsoventrally, widest between segments III-V, brownish. Cerci elongated, surpassing apex of subgenital plate, cercomeres cylindrical.


Fig. 13-17. - Vates marmorata n. sp., female morphology, allotype MNHN EP7506. - 13, Head, frontal view. - 14, Details on ocellar tubercles process, frontal view. - 15, Mesothoracic legs, dorsal view. - 16, Metathoracic legs, dorsal view. - 17, Pronotum, dorsal view.

Etymology. - The specific epithet refers to the marbling that decorates the forewings of the female (and the two diffuse spots around the stigma in the male).

Distribution. - Fig. 46. Currently only known from French Guiana; probably in Suriname and Brazil, countries bordering southern localities.

DNA barcoding. - Four sequences were obtained from the four specimens sampled. BINs (Barcode Identification Number) have been attributed to them: BOLD:ADV7963 for V. marmorata n . sp. DNA barcodes place $V$. marmorata n . sp. near $V$. biplagiata on the NJ tree with less $2 \%$ minimum p-distance (table III, fig. 45). This proximity seems to be confirmed by the morphology of both sexes, large tubercles on pronotum and forewings with marbling. But V. biplagiata can be distinguished by the coloration of female hindwings and genitalia male conformation.

## Vates patrinata n. sp.

https://zoobank.org/NomenclaturalActs/C1221905-6DDF-4237-B22A-9E0DB2A2ED49
Holotype: ô pinned (fig. 18-19), French Guiana, Kourou, piste Denis, projet ANR SPHINX, PAR19-F3, light trap, $-52.758861,5.082809$, alt. $71 \mathrm{~m}, 3 . \mathrm{II} .2019$, BOLD GFMAN18-208, Genitalia prep. NM0216, MNHN-EP7494, leg. T. Decaëns \& R. Rougerie [MNHN].

Allotype: $+\frac{1}{\text { pinned (fig. 20-21), French Guiana, Régina, mont Chauve, light trap, -52.73811, }}$ 3.82114, alt. 200 m , 14.VIII.2018, BOLD GFMAN18-056, MNHN-EP7495, leg. SEAG team [MNHN].

Paratypes (9 $\mathrm{\delta}^{\lambda}$ ): $1 \mathrm{\delta}^{\lambda}$, French Guiana, degrad Corrèze, N2, pk62, light trap, -52.3321, 4.5183, alt. $50 \mathrm{~m}, 10-23 . \mathrm{X} .2009$, BOLD NMMAN11-0194, MNHN-EP7499, leg. A. Cahurel [MNHN]; 1 §', Kourou, Matiti, light trap, VI.2013, BOLD GFMAN18-039, MNHN-EP7498, leg. J.-L. Giuglaris [MNHN]; 1 §', Mana, Laussat, montagne de Fer, ONF, light trap, -53.6057, 5.3025, 3.III.2014, BOLD NMMAN11-0357, MNHN-EP7501, leg. T. Decaëns [MNHN]; 1 § Camopi, mont Saint-Marcel, light trap, $-53.016388,2.384722$, alt. 635 m , 23.IX.2014, BOLD GFMAN18-038, MNHN-EP7503, leg. SEAG team [MNHN]; $1 \lambda^{\text {T, }}$, Saint-Georges-de-l'Oyapock, piton rocheux d'Armontabo, light trap, -52.3, 3.72, 14.II.2018, BOLD GFMAN18-074, MNHN-EP7500, leg. SEAG team [MNHN]; 2 亿, Régina, mont Chauve, light trap, -52.73811, 3.82114, 14-15.VIII.2018, BOLD GFMAN18-058 [RCNM], and BOLD GFMAN18-082, MNHN-EP7502, leg. SEAG team [MNHN]; 2 §, Kourou, piste Denis, Project ANR SPHINX, PAR19-F5, light trap, -52.760241, 5.095134, alt. $61 \mathrm{~m}, 6 . \mathrm{II} .2019$, BOLD GFMAN18-184, Genitalia prep. NM0214, MNHN-EP7496 and BOLD GFMAN18-183, Genitalia prep. NM0215, MNHN-EP7497, leg. T. Decaëns \& R. Rougerie [MNHN].

Other material examined. - $66 \widehat{\delta}$, French Guiana: $2 \widehat{\delta}$, Saint-Jean \& Saint-Laurent-du-Maroni, 1919, leg. E. Le Moult [MNHN]; 1 §, Saint-Laurent-du-Maroni, I.1980, leg. J. Boudinot, P. Thiaucourt \& H. de Toulgoët [MNHN]; 1 § , Roura, route de Kaw, pk33, II.1985, leg. G. Tavakilian [MNHN]; 3 §, Montsinery, piste FRG, pk5, 23.III.1985, leg. S. Boucher [MNHN]; 3 §, Matoury, Cayenne, route de l'Est, pk10, VIII.1986, leg. J. Orousset [MNHN]; 1 §, Roura, piste Coralie, pk2, 14.XI.1988, leg. P. Kindl [MNHN]; 1 §, Sinnamary, Petit-Saut, 1.XI. 1989 [MNHN]; 1 §, Roura, piste Coralie, pk2, 2.III.1991, leg. P. Cerdan [MNHN]; 1 §̉, Saül, mont La Fumée, 30.IV.1991, leg. P. Cerdan [MNHN]; 2 §, Roura, piste Coralie, pk2, IV.1993, leg. J. Navatte \& H. de Toulgoët [MNHN]; 1 §, Kourou, Centre spatial, 20.VII.1993, leg. P. Peters [MNHN]; 1 §, Sinnamary, Petit-Saut, pk18, 9.XII.1993, leg. L. \& A. Sénécaux \& P. Thiaucourt [MNHN]; 3 §̃, Saint-Laurent-du-Maroni, saut Dalles, 7.II \& 11.V.1994, leg. P. Peters [MNHN]; 2 Ø̄, Roura, piste de Kaw, pk79, 10.I.1997, leg. A. François [MNHN]; 1 §̄, Roura, piste Coralie, pk10.6, 7.II.1997, leg. A. François [MNHN]; 1 §, I.2001, leg. A. Cahurel [RCNM]; $2 \widehat{ }{ }^{\lambda}$, Regina forest, N2, pk119, forest road, 22.II-9.III.2006, leg. A. Cahurel [RCNM]; 1§, Mana, RNN Trinité, Aya, $-53.4025,4.6022$, alt. $141 \mathrm{~m}, 30 . X .2008$, leg. A. Lévêque (fig. 23); 1 §̉, degrad Corrèze, auberge Orpailleurs, N2, pk62, 18.II-4.III.2009, leg. A Cahurel [RCNM]; 1 §, Nouragues, CNRS station, inselberg, light trap, I.2011, leg. T. Decaëns [RCNM]; 1 §, Kaw, pk36, light trap, 20.VII.2012, BOLD NMMAN11-0167 [RCNM]; 1 §̃, Roura, montagne des Chevaux, PGL, -52.4314, 4.7421, alt. 45 m, 22.VI.2013, leg. SEAG team [MNHN]; 1 §̃, Apatou, pk25, light trap, -54.339609, 5.154832, alt. 27 m, 6.VIII.2013, leg. SEAG team [MNHN]; 1 §, Saül, 14.X.2013, leg. ASPER team [MNHN]; $1 \delta^{\lambda}$, Iracoubo,


Fig. 18-19. - Vates patrinata n. sp., $\widehat{\delta}^{\widehat{1}}$ holotype MNHN EP7494, habitus. - 18, Dorsal view. - 19, Ventral view.


Fig. 20-21. - Vates patrinata n. sp.,,+ allotype MNHN EP7495, habitus. - 20, Dorsal view. - 21, Ventral view.
Trou-Poissons, PVB, -53.088076, 5.431518, alt. 7 m, 7.V.2014, leg. SEAG team [MNHN]; 3 § ${ }^{\text {h }}$, Camopi, mont Saint-Marcel, light trap, PVB, PVP, -53.016388, 2.384722, alt. 635 m, 21-26.IX.2014, leg. SEAG team [MNHN]; 1 §', Maripasoula, Mitaraka, crique Alama, Drop Zone, "Our Planet Reviewed" 2015, MNHN/PNI Guyane (APA-973-1), -54.513666, 2.298966, alt. 300 m , 25.II-26.III.2015, leg. E. Poirier, J. Touroult, P.-H. Dalens, S. Hugel, F. Legendre [MNHN]; 4 §, Maripasoula, Mitaraka, crique Alama, Drop Zone, "Our Planet Reviewed" 2015, MNHN/PNI Guyane (APA-973-1), -54.478883, 2.239458, alt. 300 m, 12-20.VIII.2015, leg. P.-H. Dalens, S. Brûlé \& F. Robin [MNHN]; 3 ठ̉, montagne des Chevaux, PVP, -52.4314, 4.7421, alt. 45 m , 28.II-19.XII.2015, leg. SEAG team [MNHN]; 5 § ${ }^{\text {® }}$, montagne des Chevaux, PVB, -52.4314, 4.7421, alt. 45 m, 26.VII.2014-21.V.2016, leg. SEAG team [RCNM]; $1 \delta^{\imath}$, Mana, Angoulême, PVP, -53.655, 5.41, alt. 20 m, 5.VIII.2016, leg. SEAG team [MNHN]; 1 §', Saint-Elie, RNN Trinité, Drop Zone Aya, light trap, -53.3, 4.56667, 3.XI.2018, leg. SEAG team [RCNM]; 14 ठ, Roura, montagne des Chevaux, Canopy, light trap \& CUV, -52.4314, 4.7421 , alt. 45 m, 8.IX-4.XII.2018,
leg. SEAG team [RCNM]; 1 §̉, Roura, montagne des Chevaux, CVB, $-52.4314,4.7421$, alt. 45 m , 29.XII.2018, leg. SEAG team [RCNM]; 2 , , Roura, montagne des Chevaux, CUV, -52.4314, 4.7421, alt. 45 m, 5.I. 2019 \& 12.I.2019, leg. SEAG team [RCNM]; 2 万, Saint-Laurent-du-Maroni, plateau Serpent, bord de route, light trap, -54.139603, 5.320003, alt. $70 \mathrm{~m}, 7 . \mathrm{III} .2019$, leg. J. Lapèze [RCNM]; 3 §, Roura, montagne des Chevaux, CVB, -52.4314, 4.7421, alt. 45 m , 19.I-1.VI.2019, leg. SEAG team [RCNM]; $1 \delta^{\lambda}$, Saint-Elie, Trinité, Drop Zone mont Tabulaire, light trap, -53.3589, 4.61086, alt. 315 m, 1.IX.2021, leg. SEAG team [RCNM].

Diagnosis. - Vates patrinata n. sp. is morphologically very close to V. festae and V. biplagiata. Both sexes of $V$. patrinata n . sp. are distinguished from $V$. festae and V. biplagiata in the ocellar tubercles process with divergent apices (fig. 22-28, 35-39, 40, 45).

Females differ from V. biplagiata in forewings mostly green without brown marbling (fig. 20).
Males differ from other species of Vates by genitalia morphology, with a longer and thinner apa than V. festae and V. biplagiata (fig. 29-34). Males differ from V. festae by S-shaped antennomeres (straight comb antennomeres in V. festae) (fig. 22-23).

Description of male. - Fig. 18-19, 22-34, 40, 45, table II.
Head. Eyes rounded. Vertex flat, higher than imaginary line connecting dorsal margin of compound eyes. Juxtaocular bulges flat, aligned to vertex. Ocellar tubercles bearing two well-developed conical projections, then slightly spaced at the apex (variation of this character across examined specimens can be seen in fig. 23-24). Central ocellus rounded, lateral ocelli elliptical. Antennae with scape light brown, rest of antenna dark brown, proximal-most antennomeres cylindrical, rest S-shaped, conferring antennae with a pectiniform appearance, distal-most antennomeres more or less filiform. Lower frons sub-pentagonal, wider than high, smooth, medially darkened, upper margin arcuate and concave. Maxillary palps light brown, except the two first segments and the last one, dark brown; inner margin of labial palps darkened, upper margin light brown.

Table II. - Vates patrinata n . sp., measurements of types and non-types adult female and males.

|  | ठ holotype [MNHN] | $\begin{aligned} & q \text { allotype } \\ & {[\mathrm{MNHN}]} \\ & \hline \end{aligned}$ | $\widehat{o}$ average (range) from 25 specimens * |
| :---: | :---: | :---: | :---: |
| 1. Body length | 47.1 | 49.8 | 48.6 (45.4-51.4) |
| 2. Forewings length | 34.4 | 37.9 | 34.8 (31.6-37.4) |
| 3. Hindwings length | 31.9 | 35.0 | 32.5 (30.1-34.5) |
| 4. Pronotum length | 17.6 | 20.0 | 18.0 (16.-19.8) |
| 5. Prozona length | 3.7 | 4.3 | 3.8 (3.3-4.2) |
| 6. Pronotum width | 4.2 | 5.3 | 4.2 (3.7-4.5) |
| 7. Pronotum width/length [ratio] | 0.24 | 0.27 | 0.23 (0.21-0.25) |
| 8. Pronotum posterior margin width | 2.4 | 3.2 | 2.4 (2.0-2.8) |
| 9. Head width | 6.1 | 6.7 | 5.8 (5.5-6.2) |
| 10. Frons width | 1.8 | 2.2 | 1.8 (1.6-2.0) |
| 11. Frons height | 0.8 | 1.3 | 0.8 (0.7-1.0) |
| 12. Forecoxae length | 9.7 | 10.8 | 9.8 (8.7-10.5) |
| 13. Forefemora length | 11.1 | 13.3 | 11.5 (10.7-12.8) |
| 14. Mesofemora length | 10.0 | 11.2 | 9.9 (8.7-11.4) |
| 15. Mesotibiae length | 7.2 | 8.1 | 7.6 (6.8-8.7) |
| 16. Mesotarsi length | 5.2 | 5.7 | 5.6 (4.7-6.1) |
| 17. Metafemora length | 11.9 | 13.8 | 12.3 (11-13.9) |
| 18. Metatibiae length | 10.0 | 11.1 | 10.0 (9.0-10.9) |
| 19. Metatarsi length | 7.3 | 7.7 | 7.5 (6.5-8.2) |
| 20. Anteroventral femoral spine [count] | 15 | 15 | 15 |
| 21. Anteroventral tibial spine [count] | 15 | 13 | 14-16 |
| 22. Posteroventral tibial spine [count] | 11 | 11 | 9-13 |

[^1]Thorax. Pronotum elongated, metazona triangular in cross-section. Supracoxal dilatation moderately pronounced and broadly rounded; ratio metazona/prozona $=3.59$ (holotype) (variation across male paratypes 3.44-4.29). Distal margin of prozona uniformly curved, margins with small, spaced out, blunt tubercles, denser along margins of supracoxal dilatation; metazona with large dark tubercles, alternating with smaller ones, which decrease in density proximally. Dorsal surface of metazona keeled along its midline (keel more pronounced proximally). Pronotum predominantly brown, and a black area at the height of the enlargement of the supracoxal dilatation.

Prothoracic legs. Coxae triangular in cross-section, ventral margin pale yellowish brown, except for a small and distally positioned dark spot on its anterior aspect, and a larger preapical spot posteriorly, just before forecoxal lobes; dorsal margin bearing four spine-like, darkened tubercles interleaved with smaller, paler ones; dorsal side of forecoxae brown with two paler bands and scattered small, dark and paler tubercles. Spination formula: $\mathrm{F}=4 \mathrm{DS} / 15 \mathrm{AvS} / 4 \mathrm{PvS} ; \mathrm{T}=15 \mathrm{AvS} / 11 \mathrm{PvS}$ (holotype); $\mathrm{F}=$ 4DS/15AvS/4PvS; T = 14-16AvS/9-12PvS (other specimens). Ventral side of forefemora light brown, three-banded, with a small dark spot near trochanter; dorsal margin slightly sinuous; discoidal spines I, II and III mostly pale with darkened apex, spine IV entirely black; anteroventral spines I, II, III, IV, V, VI, VIII, X, XII and XV entirely dark, spine XV larger than the others; remaining spines smaller, pale at the base, and with darkened apex; spine size arrangement: iiiiiiiiiiiiiiI; genicular spurs developed and present on both sides of femora; tibial spur groove located almost in middle of femora. Foretibiae light brown, dorsally three-banded.

Wings. Forewings surpassing abdomen by $1 / 4$ of their length in resting position, with membrane of costal area opaque and predominantly green (yellow when discoloration cause of conservation), and a whitish longitudinal strip along margin of costal vein, distal-most portion of costal vein and membrane around radial vein darkened; discoidal area entirely hyaline with yellowish longitudinal veins, apex slightly darkened, with more densely reticulate venation. Anal area small, veins whitish. Hindwings hyaline and colourless, yellowish longitudinal veins, apex of discoidal area densely reticulated and dark brown; anal area largely hyaline, veins whitish.

Meso- and metathoracic legs. Mesofemora with a posteroventral keel forming two evident lobes: a well-produced, rounded proximal one, and an also well-produced pre-apical one, shaped like an elongated shark's dorsal fin; with an anteroventral keel forming a very slightly pre-apical lobe. Metafemora with a marked posteroventral keel forming a pre-apical lobe shaped like a shark's dorsal fin; with an anteroventral keel forming an elongated and rounded little pre-apical lobe. Mesotibiae with two medial lobes, produced and shaped like shark's dorsal fin; and two apical lobes, an elongated but scarcely produced anterodorsal one, and an almost equally produced anteroventral one. Metatibiae with two produced medial lobes, also shaped like shark's dorsal fin, but posteroventral one more rounded; and two elongated, less produced apical lobes.

Abdomen slightly compressed dorsoventrally, widest between III-V, brownish. Supraanal plate triangular, wider than longer, rounded. Cerci cylindrical and elongated, not surpassing apex of subgenital plate, last cercomere conical.

Genitalia. Left phallomere with sclerite L4B longer than wide, its left margin projects anteriorly; anterior process (afa) glabrous, sinuous, basal half broad but tapering distally, apex more strongly sclerotized, with sharp, pointy apex; posteromesal lobe (loa) elongated and sinuous, glabrous, lacking projections; posterior process (рaa) elongated, curved. Ventral phallomere with sclerite L4A roughly rectangular, proximal left margin slightly sinuous and more sclerotized; lateral secondary process (sdpl) elongated, thin, and apex strongly sclerotized and tapering distally, uniformly curved right. Right phallomere: roughly triangular, distal margin folded anteriorly; anterior apodeme (an) of sclerite R3 elongated, distally broadened, main posterior lobe (fda) with a relatively broad dextral extension (bm); process anteromesal to pia (pva) curved ventrally, strongly sclerotized, with a rounded apex; process posterolateral to pva (pia) rounded and well sclerotized.

Description of female. - Fig. 20-21, 35-39, 45, table II.
Head. Eyes rounded. Vertex flat, higher than imaginary line connecting dorsal margin of compound eyes. Parietal suture darkened, juxtaocular bulges flat and aligned to vertex. Ocellar tubercles bearing two well-developed conical projections, then slightly spaced at the apex. Ocelli rounded, lateral ocelli twice as large as central ocellus. Antennae filiform, scape and pedicel light brown, flagellomeres dark brown. Lower frons sub-pentagonal, wider than high, smooth, medially darkened, upper margin arcuate,


Fig. 22-28. - Vates patrinata n. sp., male morphology, holotype MNHN EP7494. - 22, Head, frontal view. - 23, Details on ocellar tubercles process, frontal view. - 24, Variation on ocellar tubercles process, frontal view, paratype MNHN EP7497. - 25, Forecoxae, ventral view. - 26, Forewings, details on costal area, dorsal view. - 27, Mesothoracic legs, dorsal view. - 28, Metathoracic legs, dorsal view.
smooth and concave. Maxillary palps light brown except the two first segments and $2 / 3$ of the third, dark brown; inner margin of labial palps darkened, upper margin light brown.

Pronotum elongated, metazona triangular in cross-section. Supracoxal dilatation moderately pronounced and broadly rounded; ratio metazona/prozona $=3.72$. Distal margin of prozona uniformly curved, margins with small, spaced out, blunt tubercles, denser along margins of supracoxal dilatation; metazona with large dark tubercles, alternating with smaller ones, decreasing in density proximally. Dorsal surface of metazona keeled along its midline (keel more pronounced proximally). Pronotum predominantly brown, with darker little spots (sometimes with a small tubercle on the prozona) and a black area at the height of the enlargement of the supracoxal dilatation.

Prothoracic legs. Coxae triangular in cross-section, ventral margin pale yellowish brown, except for a small and distally positioned dark spot on its anterior aspect, and a larger preapical spot posteriorly,


Fig. 29-30. - Vates patrinata n. sp., male genital structures, holotype MNHN EP7494. - 29, Ventral view. - 30, Dorsal view. [afa: anterior process (left phallomere); an: anterior apodeme; bm: dextral extension; fda: main posterior lobe (with R1 sclerotization); $L 4 A$ : sclerite extending over the ventral wall (ventral phallomere); $L 4 B$ : sclerite extending over the dorsal wall (left phallomere); loa: posteromesal lobe (left phallomere); paa: posterior process (left phallomere); pda: posterior process (ventral phallomere); pia: process posterolateral to pva (right phallomere); $p v a$ : process anteromesal to pia (right phallomere); R3: anteriorly extending sclerite (right phallomere); sdpl: lateral secondary distal process].
just before forecoxal lobes; dorsal margin bearing four spine-like, darkened tubercles interleaved with smaller, paler ones; dorsal side of forecoxae brown with two paler bands and scattered small, dark and paler tubercles. Spination formula: $F=4 D S / 15 A v S / 4 P v S ; ~ T=13(L)-14(R) A v S / 11 P v S$. Ventral side of forefemora light brown, three-banded, with a small dark spot near trochanter; dorsal margin slightly sinuous; discoidal spines I, II and III mostly pale with darkened apex, spine IV entirely dark; anteroventral spines I, II, IV, VI, VIII, X, XII and XV entirely dark, spine XV larger than the others; remaining spines smaller, pale, slightly green at the base and with darkened apex; spine size arrangement: iIiIiIiIiIiIiiI; genicular spurs developed and present on both sides of femora; tibial spur groove located in middle of femora. Foretibiae light brown, dorsally three-banded.


Fig. 31-34. - Vates patrinata n. sp., male genital structures. 31, Ventral view, paratype MNHN EP7496. - 32, Ventral view, paratype MNHN EP7497. - 33, Partial ventral view on sdpl, paratype MNHN EP7496. - 34, Partial ventral view on sdpl, paratype MNHN EP7497.


Fig. 35-39. - Vates patrinata n. sp., female morphology, allotype MNHN EP7495. - 35, Head, frontal view. - 36, Details on ocellar tubercles process, frontal view. - 37, Mesothoracic legs, dorsal view. - 38, Metathoracic legs, dorsal view. - 39, Pronotum, dorsal view.

Wings. Forewings surpassing abdomen by $1 / 4$ of their length in resting position, with membrane of costal area opaque and predominantly yellow (may be a discoloration cause of conservation), probably green in live specimens, with a whitish longitudinal strip along margin of costal vein, distal-most portion of costal vein and membrane around radial vein darkened; discoidal area with green and opaque membrane, longitudinal veins green and yellowish (due to conservation), veins densely reticulated distally, stigma with a darkly pigmented spot; anal area small, mostly opaque, veins and membrane whitish. Hindwings with narrow costal area, tapering distally and partially opaque, proximal half with membrane and veins whitish, although cells become dark brown distally; discoidal area largely hyaline with yellowish veins, proximal region of membrane whitish, distal portion smoky brown, opaque and heavily reticulated; anal area largely hyaline, veins and proximal area of membrane whitish, distal portion below discoidal area faint brown.

Meso- and metathoracic legs. Mesofemora with a posteroventral keel forming two evident lobes: a well-produced, rounded proximal one, and a well-produced pre-apical one, shaped like an elongated shark's dorsal fin; with an anteroventral keel forming a scarcely produced pre-apical lobe. Metafemora with a marked posteroventral keel forming a single pre-apical lobe, also shaped like a shark's dorsal fin; with an anteroventral keel forming an elongated and triangular pre-apical lobe. Mesotibiae with two medial lobes, produced and shaped like shark's dorsal fin; and two apical lobes, an elongated but scarcely produced anterodorsal one, and an anteroventral one, almost equally produced but triangular. Metatibiae with two produced medial lobes, also shaped like shark's dorsal fin, but posteroventral one more rounded; and two elongated and less produced apical lobes.

Abdomen fusiform, slightly flattened dorsoventrally, widest between segments III-V, brownish. Cerci elongated, surpassing apex subgenital plate, cercomeres cylindrical.

Etymology. - The specific epithet refers to PatriNat (Center of expertise and data on natural heritage, OFB-MNHN-CNRS-IRD) which promotes biodiversity, and which supports the author's research on insects and in particular Mantodea.

Distribution. - Fig. 46. Currently only known from French Guiana.
DNA barcoding. - Concerning $V$. patrinata n. sp., 11 sequences were obtained from the eleven sampled specimens. DNA barcodes clearly separate $V$. patrinata n . sp. from all closely related species in a distinct cluster of sequences (table III, fig. 45). The nearest neighbour is V. biplagiata ( $4.3 \%$ minimum p-distance), from which it can be distinguished by large tubercles on margin of pronotum and lack of marbling on female hindwings.

For this study, 27 sequences were obtained from the 30 sampled specimens (fig. 45). Four nominal species are distant enough from each other to allow us to consider them as four


Fig. 40. - Vates patrinata n. sp., male in RNN la Trinité, French Guiana. (Photography by Antoine Lévêque).


Fig. 41-42. - Vates marmorata n. sp. at Papaïchton (French Guiana), November 2018 (Photography by the author). - 41, Female. - 42, Male.
different species. BINs have been attributed to them: BIN:BOLD:ACP9331 for V. biplagiata, BIN:BOLD:ADV7963 for $V$. marmorata n. sp., BIN:BOLD:ACR2406 for $V$. patrinata n . sp., and BIN:BOLD:ACP9060 for V. lobata. PCR did not work for three specimens, presumably due to their condition, as they had to be relaxed in order to be mounted, due to the age or due to the preserving liquid (table III).

## Key to species of Vates in French Guiana

## Males

1. Margins of pronotum with small teeth

- Margins of pronotum with large tubercles

2. Forewings without brown marbling around the stigma ..................................................................... 3

- Forewings with slight brown marbling around the stigma
V. marmorata n. sp.


Fig. 43-44. - Biotopes of the two new species of Vates in French Guiana. - 43, Tropical forest, Papaïchton, November 2018 (Photography by the author). - 44, Tropical forest around 'montagne des Chevaux' (Photography by Stéphane Brûlé).
3. Forewings with very contrasting colouring, without brown marbling; genitalia with lateral secondary process (sdpl) long, rather slender, and curved towards the right, its apex slightly sclerotized without marked narrowing before apex; phalloid apophysis (left phallomere) (afa) wider at base, then slightly arched and very sclerified $\qquad$ V. patrinata n . sp .

- Forewings with less contrasting colouring, with slight brown marbling towards the end of costal area; genitalia with lateral secondary process ( sdpl ) shorter, stockier, also curved at right, its apex very sclerotized with a narrowing before apex; phalloid apophysis (left phallomere) (afa) thin at base, then straight $\qquad$


## Females

1. Margins of pronotum with small teeth

- Margins of pronotum with strong tubercles 2

2. Forewings light brown and hyaline in posterior part, with brown marbling and stigma well outlined by two brown spots $V$. marmorata n . sp.

- Forewings slightly greenish and hyaline, to opaque green, with a brown stigma more or less wide .... $\mathbf{3}$

3. Forewings opaque with yellowish costal area and green discoidal area; stigma rounded and brown
V. patrinata n . sp.

- Forewings transparent, slightly greenish and brown; stigma surrounded by a small brown spot in front and a larger one behind
V. biplagiata Sjöstedt


## Clé des espèces de Vates de Guyane

## Mâles

1. Bords du pronotum avec de petites dents

Vates lobata (Fabricius)

- Bords du pronotum avec de gros tubercules 2

2. Ailes antérieures sans marbrures brunes autour du stigma ............................................................... 3

- Ailes antérieures avec de légères marbrures brunes autour du stigma ............... V. marmorata n. sp.

3. Coloration des élytres très contrastée, sans marbrures brunes. Genitalia avec le processus postérieur (sdpl) de l'hypophallus long, assez mince et courbé vers la droite, son extrémité peu sclérifiée sans rétrécissement marqué avant l'apex ; apophyse de l'épiphallus gauche (afa) plus large à la base, puis légèrement arquée et très sclérifiée
V. patrinata n . sp.

- Coloration des élytres moins contrastée et de légèrement marbrures brunes vers l'extrémité de l'aire costale. Genitalia avec le processus postérieur (sdpl) de l'hypophallus, plus court, plus trapu, également courbé vers la droite, son extrémité très sclérifiée avec un rétrécissement avant l'apex ; Apophyse de l'épiphallus gauche (afa) fine à la base, puis assez rectiligne ..... V. biplagiata Sjöstedt


## Femelles

1. Bords du pronotum avec de petites dents

Vates lobata (Fabricius)

- Bords du pronotum avec de gros tubercules

2. Élytres brun clair et transparents dans leur partie postérieure, avec des marbrures brunes et le stigma bien détouré par deux tâches brunes
V. marmorata n. sp.

- Élytres légèrement verdâtres et hyalins à verts opaques, avec un stigma brun plus ou moins grand 3

3. Élytres opaques avec l'aire costale jaunâtre et l'aire discoïdale verte ; stigma arrondi et brun ...
V. patrinata n . sp.

- Élytres transparents, légèrement verdâtres et bruns ; stigma entouré d'une petite tâche brune à l'avant et d'une plus grosse à l'arrière
V. biplagiata Sjöstedt

Table III. - Barcode Identification Numbers of Vates from French Guiana (BIN, Barcode Identification Number; DNN, Distance with Nearest Neighbour; Imax, Maximum Distance; N, number of sequences).

| Species | BIN | N | Imax <br> (p-dist) | Average <br> Distance <br> (p-dist) | DNN <br> (p-dist) | Nearest species |
| :--- | :---: | :---: | :---: | :---: | :---: | :--- |
| V. lobata (Fabricius, 1798) | BOLD:ACP9060 | 10 | $1.24 \%$ | $0.77 \%$ | $4.3 \%$ | V. patrinata n . sp. |
| V. biplagiata Sjöstedt, 1930 | BOLD:ACP9331 | 3 | $2.51 \%$ | $0.75 \%$ | $1.71 \%$ | V. marmorata n . sp. |
| V. marmorata n . sp. | BOLD:ADV7963 | 4 | $0 \%$ | $0 \%$ | $1.71 \%$ | V. biplagiata <br> Sjöstedt, 1930 |
| V. patrinata n . sp. | BOLD:ACR2406 | 11 | $0.48 \%$ | $0.16 \%$ | $4.3 \%$ | V. biplagiata <br> Sjöstedt, 1930 |

## Discussion

According to the collection locations of different individuals in the canopy, these species are considered to be arboreal (fig. 43-44). In the present study, many males were captured with a light trap, and were rarely captured during the day (fig. 40).


Fig. 45. - Barcode tree of Vates from French Guiana created in MEGA using a Maximum Likelihood analysis. Each specimen is referenced by its ProcessID (barcode number), species name and sex, and is illustrated by dorsal views. Bootstrap values are given for each node. Raptrix perspicua as outgroup taxon.

Morphological comparison of several Vates specimens provided information on the affinities of the new species. Beier (1958) described the male of V. luxuriosa, the closest species to $V$. marmorata n. sp., V. patrinata n. sp. and $V$. festae by its colouring pattern, the arrangement of the lobes on the legs, and the large tubercles on the pronotum. However, Beier (1958) indicates that antennomeres are coarse and simply conical, while they are S-shaped in V. marmorata n . sp. and $V$. patrinata n. sp. Salazar (2004) illustrated two females of $V$. festae from Colombia with divergent ocellar tubercles process. Vates festae is generally larger than V. marmorata n. sp. and V. patrinata n. sp., compared to the measurements of a male from Columbia provided by Hebard (1933). Furthermore, a few male genital structures have been illustrated, except for $V$. chopardi (Lombardo, 2000), V. biplagiata and V. festae (Medellín \& Salazar, 2011), V. lobata and V. pectinata (Schwarz \& Roy, 2019), and V. phoenix (Rivera et al., 2020). Both V. marmorata n. sp. and V. patrinata n. sp. Male genital structures show affinities with $V$. festae and $V$. biplagiata, based on the male genital structures already known.

After examining all specimens of Vates kept at both MNHN and RCNM, and using the results of DNA barcoding, I can conclude that four species of Vates inhabit French Guiana, so far: V. biplagiata, V. lobata, V. marmorata n. sp., and V. patrinata n . sp.

Svenson et al. (2016) illustrated Vates pectinata with a female and a male that look suspiciously like V. patrinata n . sp. Moreover, the male does not look like to holotype male of V. pectinata kept in the Museum of Natural History in Geneva. This observation is confirmed by Rivera et al. (2020), who stated that the male and female specimens portrayed in Svenson et al. (2016) and reported as Vates pectinata cannot be attributed to this species. It is indeed a pair of $V$. patrinata n . sp. that is illustrated in Svenson et al. (2016: figure 8C-D). In the recent synthesis on the Mantodea of French Guiana (Moulin \& Roy, 2020), the specimens of $V$. lobata were confused with $V$. amazonica which is therefore not present in the French


Fig. 46. - Distribution of Vates marmorata n. sp. (circle) and Vates patrinatan. sp. (dot) in French Guiana.
department, or is may be a synonym of $V$. lobata as suspected by Svenson et al. (2016). And specimens of $V$. luxuriosa and $V$. biplagiata have been confused with $V$. marmorata n . sp. and $V$. patrinata n. sp. In the publication of the results of "Our Planet Reviewed" 2015, a large-scale biotic survey in Mitaraka, French Guiana (Roy, 2019; Touroult et al., 2021), the specimens of $V$. amazonica were confused with $V$. marmorata n . sp. and $V$. patrinata n . sp. Thus, this present work will update the French national taxonomic reference system TAXREF (Brûlé \& Touroult, 2014; Gargominy et al., 2022).

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[^0]:    * including types and non-types specimens.

[^1]:    * including types and non-types specimens.

