

Plazi – on expedition to discover known biodiversity

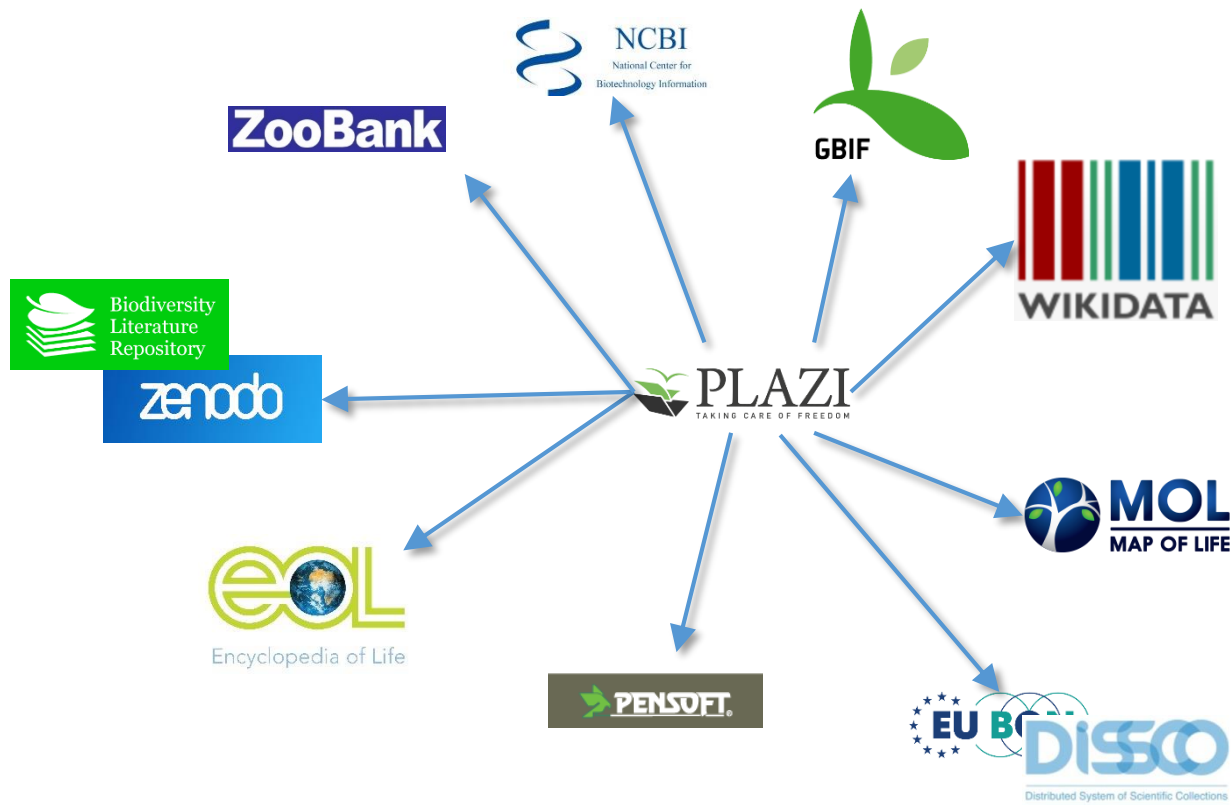
Donat Agosti
Plazi

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ORCID: 0000-0001-9286-1200

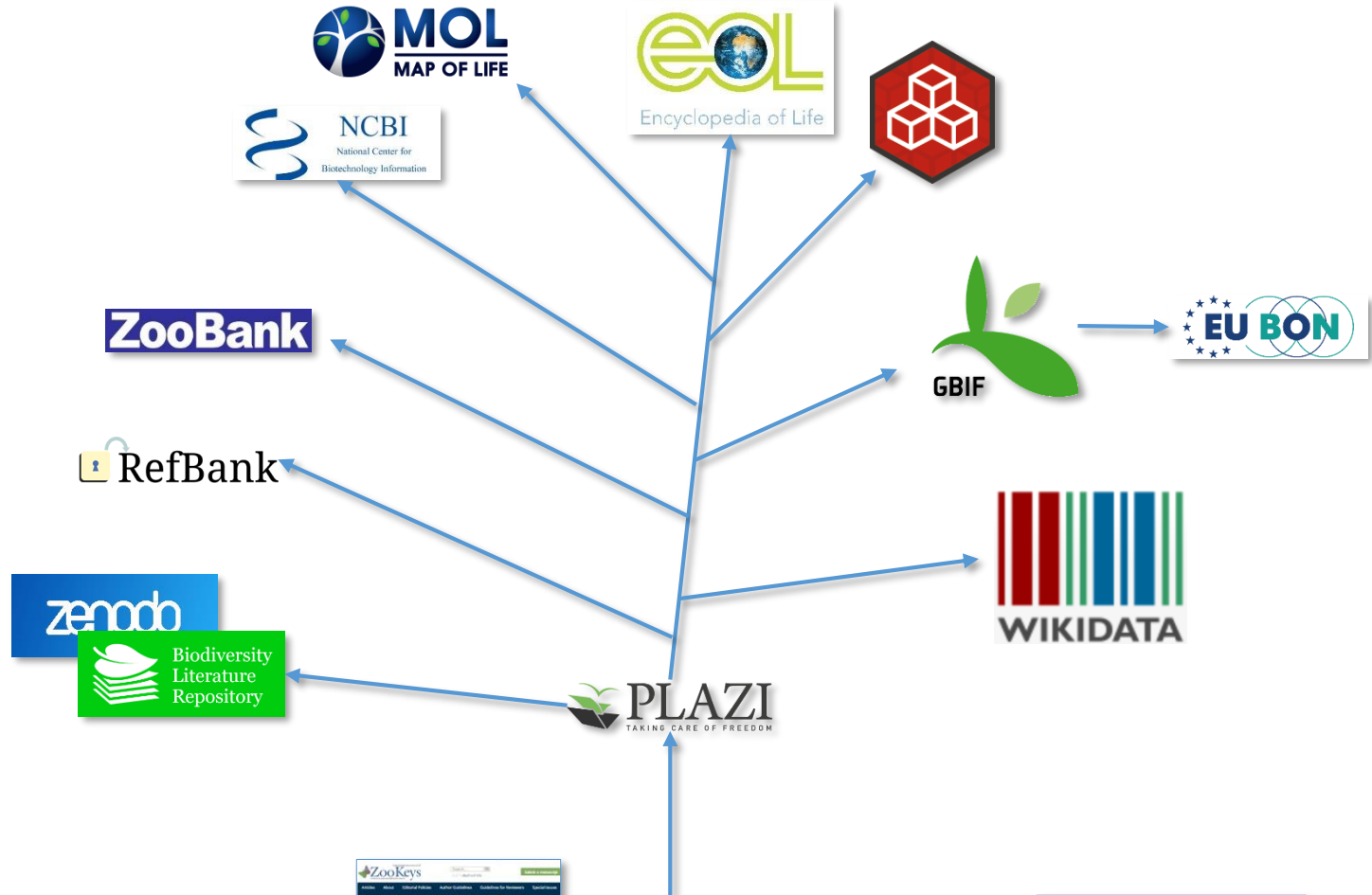
August 10, 2018, New York Botanical Garden, New York



A partner in a global science network



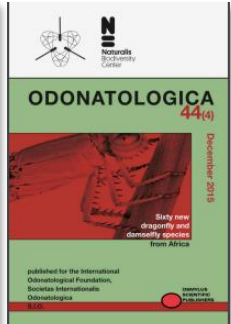
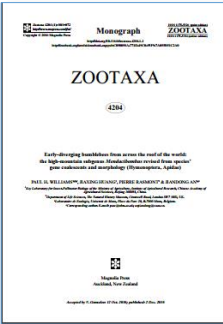
Plazi promotes open science, is innovative, and complementary to existing activities.



Reuse of **subarticle parts**



Plazi text and data mining output 2017



| | |
|--------------------------|---------|
| Journals | 132 |
| Articles | 8,545 |
| Taxonomic treatments | 69,539 |
| New species | 6,387 |
| Observation records | 45,381 |
| Figures | 56,692 |
| Bibliographic references | 267,728 |
| Facts | >>10 M |



The screenshot displays the Plazi website's main interface. At the top left is the logo with the text "PLAZI TAKING CARE OF FREEDOM". A navigation menu includes "News", "Resources", "Projects", "Activities", "Cooperation", "API & Tools", and "About", along with a "Search" button. The main content area features a world map with various taxonomic labels and their geographic locations. On the left side of the map, there are two white boxes: "Today's new taxa" and "New material citations". Below these, statistics are listed: "Articles: 23378", "Treatments: 231688", "Occurrences: 36552", "Observation Records: 159683", and "Observation Records Geo-referenced: 57223". A search bar is positioned in the top right of the map area. The bottom right corner of the map includes the text "© Mapbox © OpenStreetMap Improve this map".

Today's new taxa

New material citations

Articles: 23378
Treatments: 231688
Occurrences: 36552
Observation Records: 159683
Observation Records Geo-referenced: 57223

Search

Dirhinosisia cervinella (Eversmann, 1844)
Athrips nigrilineella Bidzilya & K. Nuppenon
kurlensis Zezina, 1976
Moriphila furva Burckhardt & Cho
Leptogenys bharti Wachkoo, Maqbool, Akbar & Sharaf, 2018
Sinella maolanensis
Hemidactylus siva
Trimma meilyae
Afrocampe prinsloo
Psilopa pectinata Hendel, 1931
Grotea santandereana
Psmizopelma macropterum
Cheiromyia nordestina
Unachlorus rafaeli
Euplocania ariasi
Psmizopelma macropterum
Psmizopelma macropterum

© Mapbox © OpenStreetMap Improve this map

23,378 articles processed
231,688 taxonomic treatments
159,583 observation records
semi- to fully automated import treatments

Biolitrepo.org

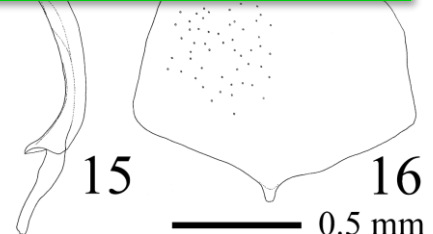
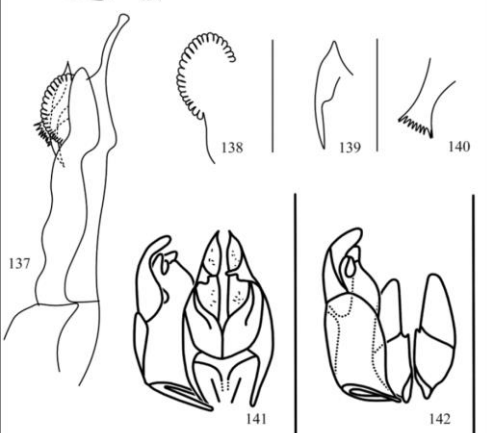
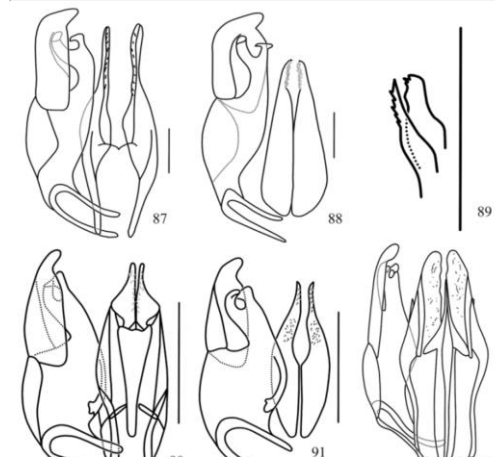
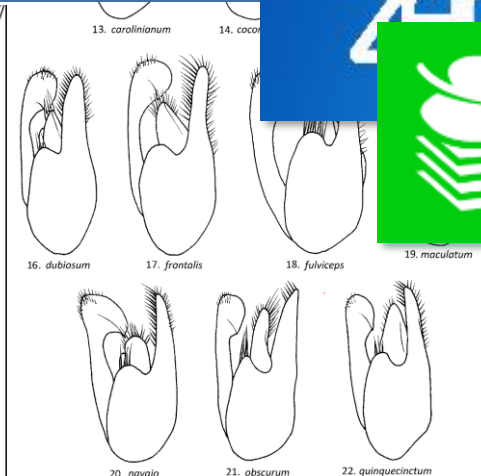
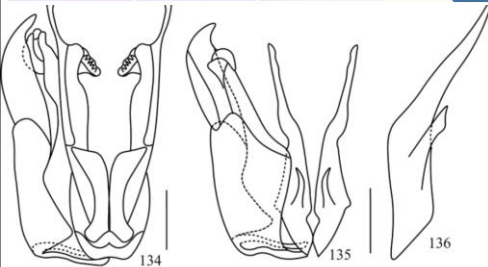
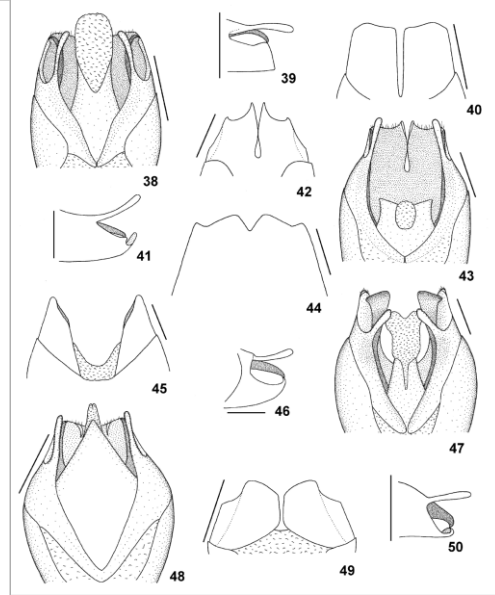
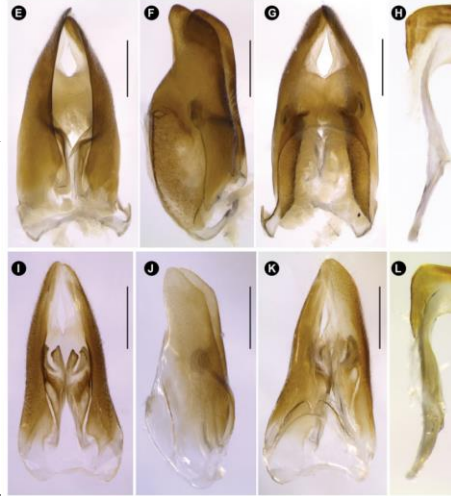
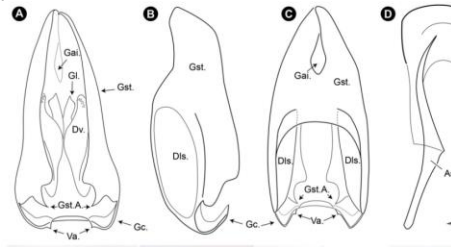
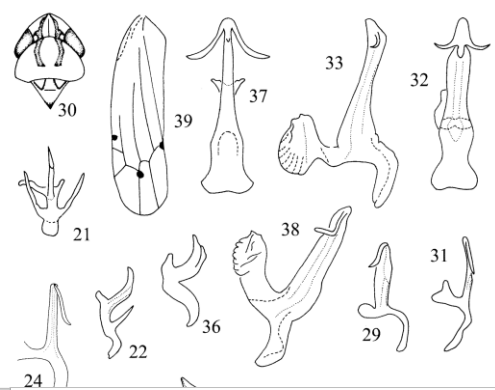
All based on published results
DOI for all deposits

All deposits linked to source

- 34,238 articles
- 184,645 images

Collaboration with CERN and Pensoft

zenodo



Source: BLR
https://zenodo.org/communities/biosyslit/search?page=1&size=200&keyword=s=hymenoptera&q=aedeagus&file_type=png



JATS TaxPub

Journal **A**rticle **T**ag **S**uit, **T**axonomic **P**ublication extension

Developed for and used to semantically enhance taxonomic literature

In collaboration with the National Library of Medicine

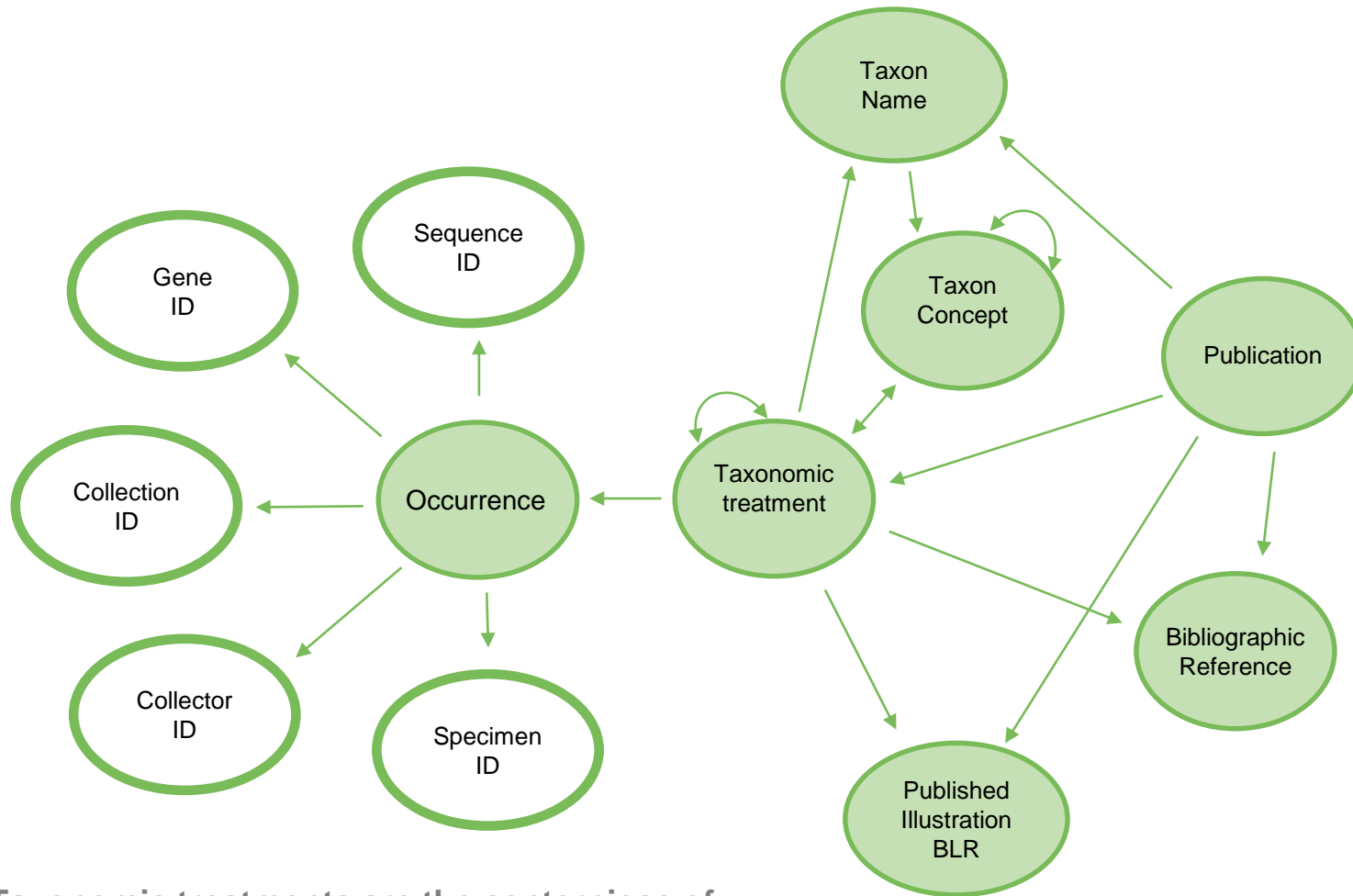
Semantic elements added for taxonomy

- if terms are in TWDG reused
- if not available, creation of complementing vocabulary

JATS is used to import scholarly articles into Pub Med Central

-> make it part of the world largest corpus of biomedical literature

TaxPub is used by Pensoft publishers and European Journal of Taxonomy

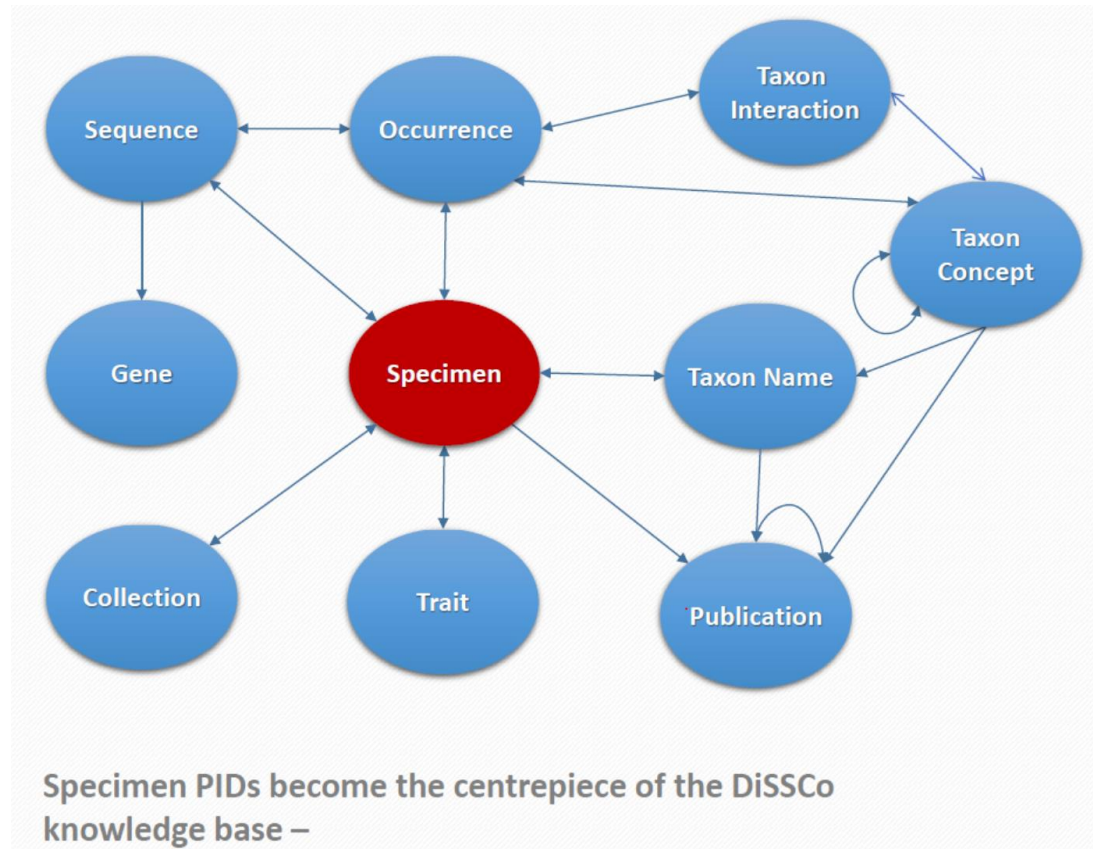


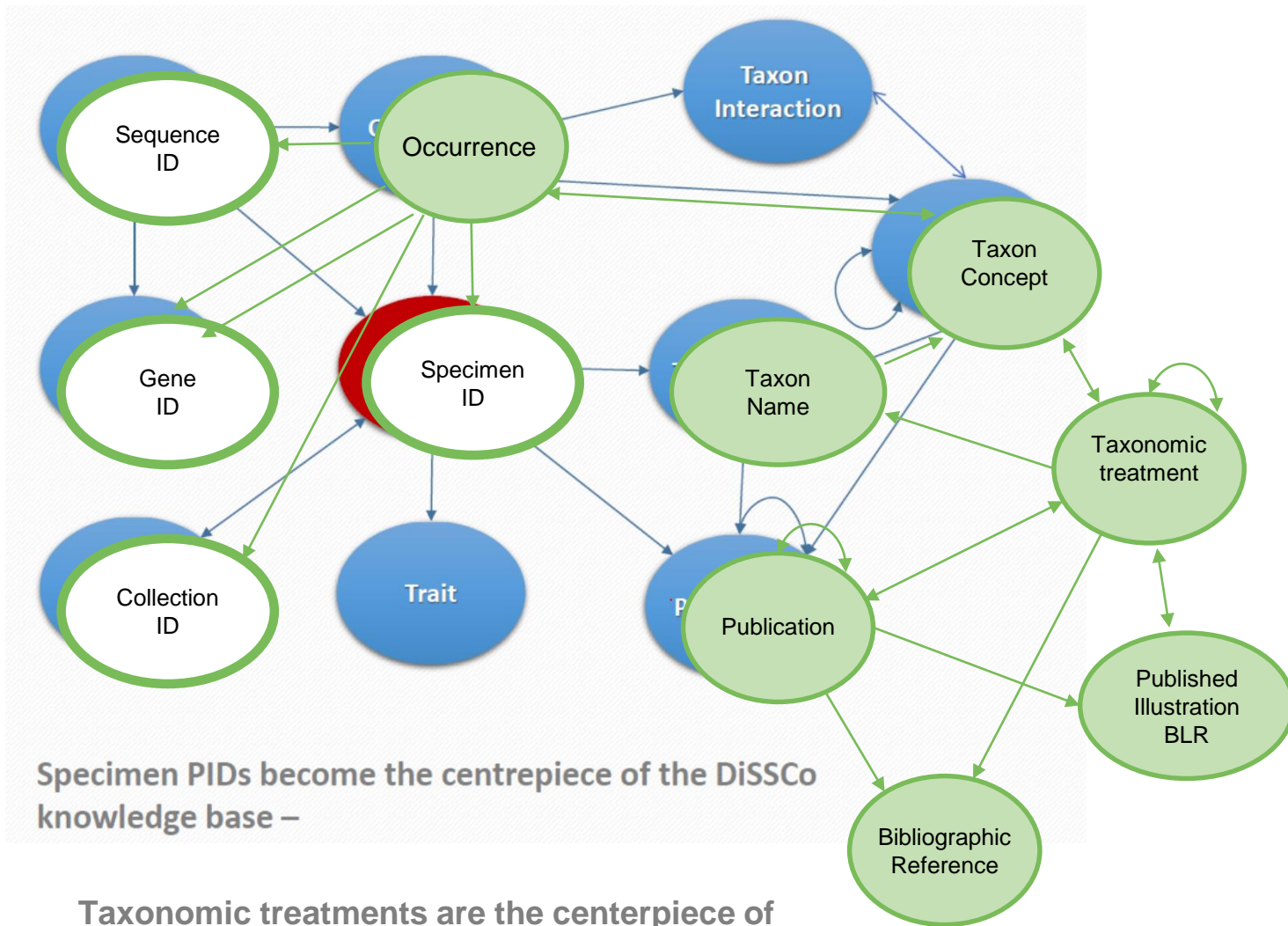
Taxonomic treatments are the centerpiece of the TreatmentBank (Plazi) and the Open Biodiversity Knowledge Management System (OBKMS)



Distributed System of Scientific Collections

DiSSCo is a new pan-European Research Infrastructure initiative of 21 European countries with a vision to position European natural science collections at the centre of data-driven scientific excellence and innovation in environmental research, climate change, food security, one health and the bioeconomy.





Specimen PIDs become the centrepiece of the DiSSCo knowledge base –

Taxonomic treatments are the centerpiece of Plazi's TreatmentBank and names of the Open Biodiversity Knowledge Management System (OBKMS)



Arcadia Fund award

Promote the *Biodiversity Literature Repository* as a way to liberate data from scholarly publications, especially by building and index to publications through illustrations

Provide taxonomic treatments and related data for >50% of new described species annually

Make these data accessible through collaborations, promote TaxPub based publishing and Text and Data Mining of articles from highly relevant journals, including back issues

3 years (2018-21), 1.1M Euro



Plazi is

- competent, activist, innovator, catalyst and leader in biodiversity informatics
- complementing ongoing efforts
- collaborator in the global biodiversity landscape
- building science infrastructure for science
- is independent, passionate and a “long” track record
- operating in Switzerland with copyright more favorable for text and data mining



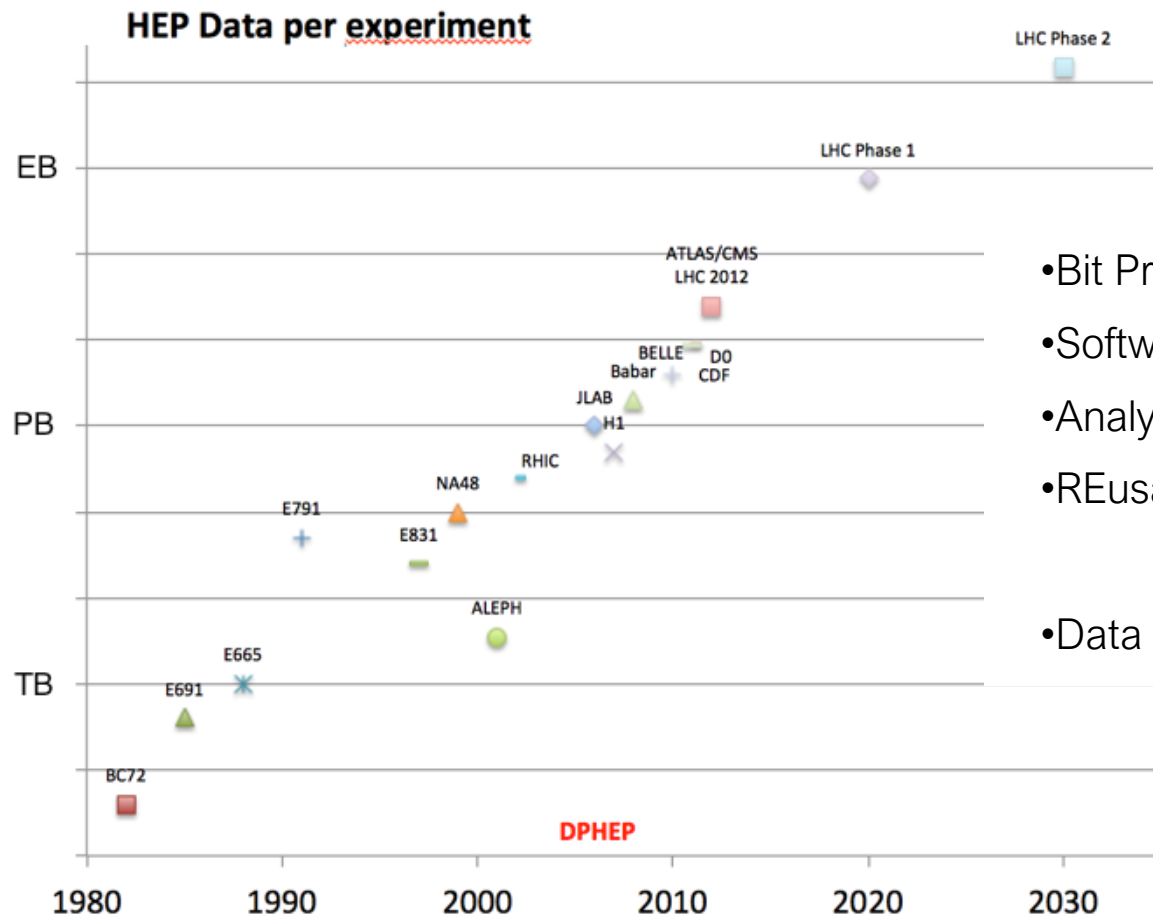
NEWS | 6 JULY 2018

Big data for biodiversity: GBIF.org surpasses 1 billion species occurrences

Milestone represents a collective effort to share evidence of our planet's biodiversity by more than 1,200 institutions in 123 countries—and more than 1 million researchers and citizen scientists worldwide



Preservation: Driven by Science



- Bit Preservation: ISO 16363 standard
- Software preservation
- Analysis Preservation
- REusable ANALyses

- Data Seal of Approval

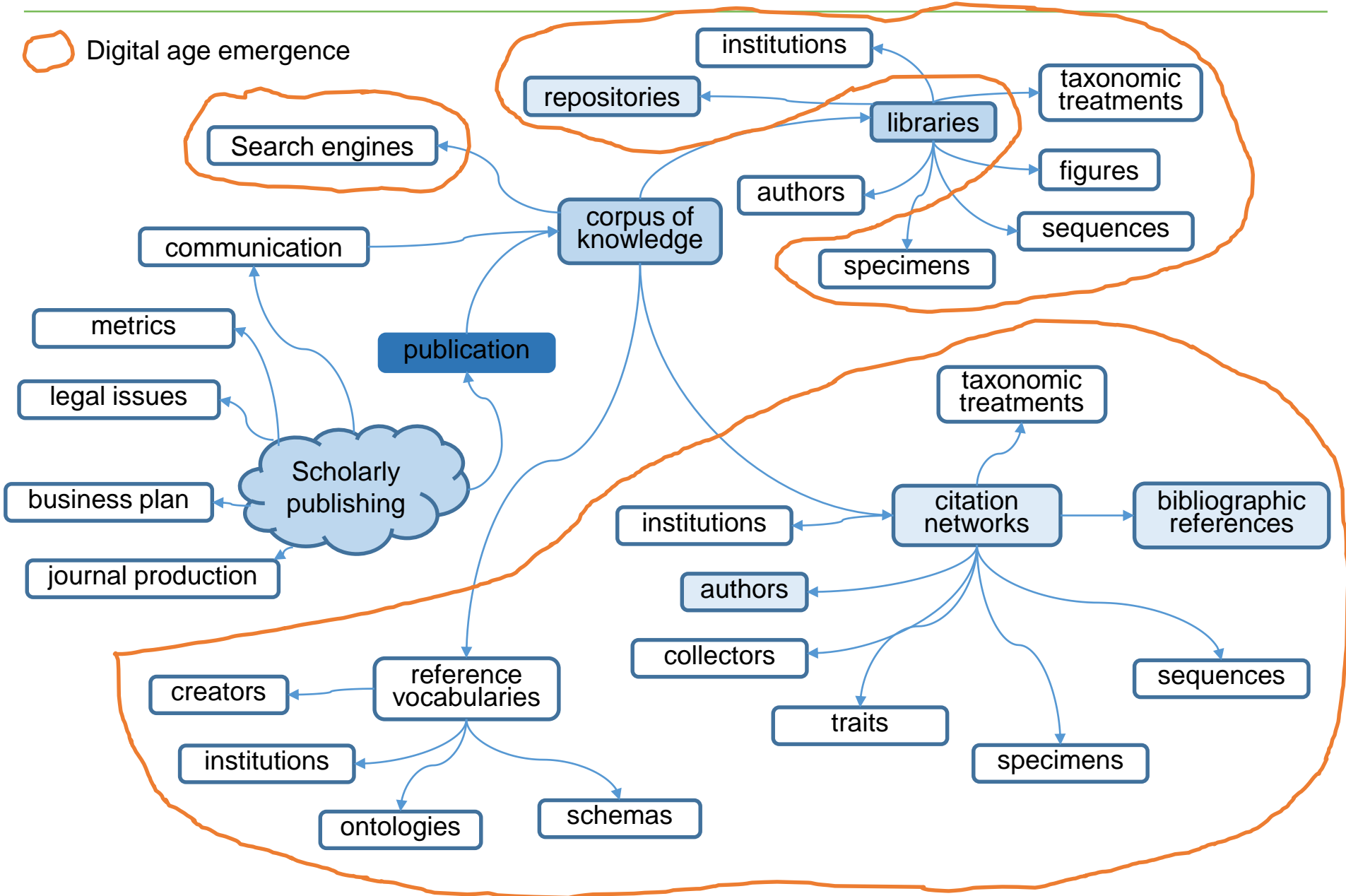
HEP: Hight Energy Physics, DPHEP: Digital Preservation in Hight Energy Physics,

TB = Terabyte, PB = Petabyte, EB = Exabyte

Scholarly publishing: a daunting task

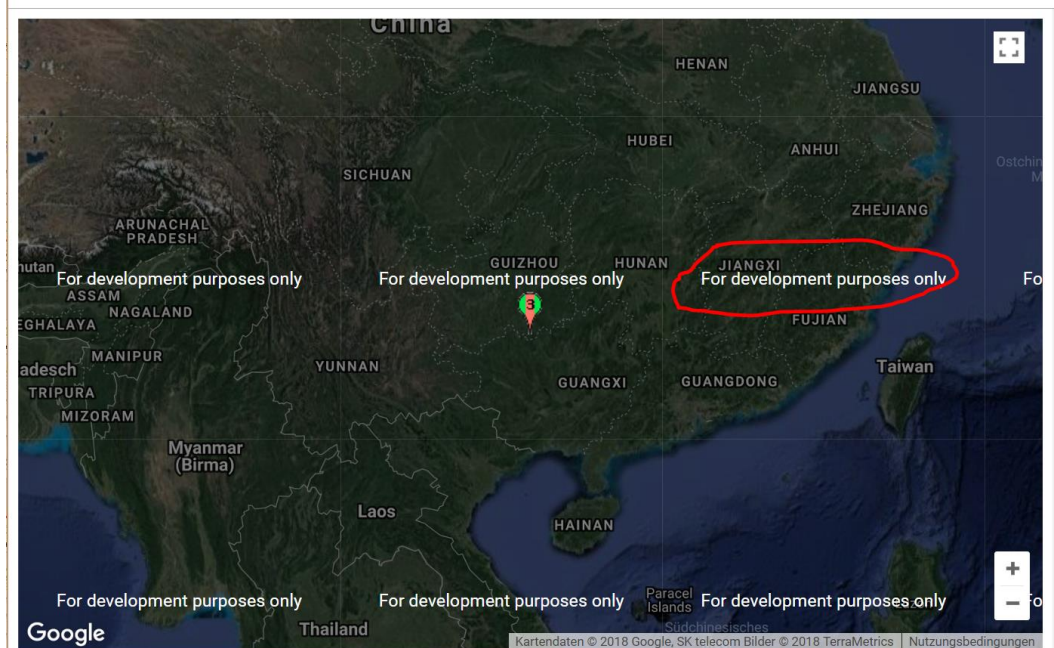


 Digital age emergence



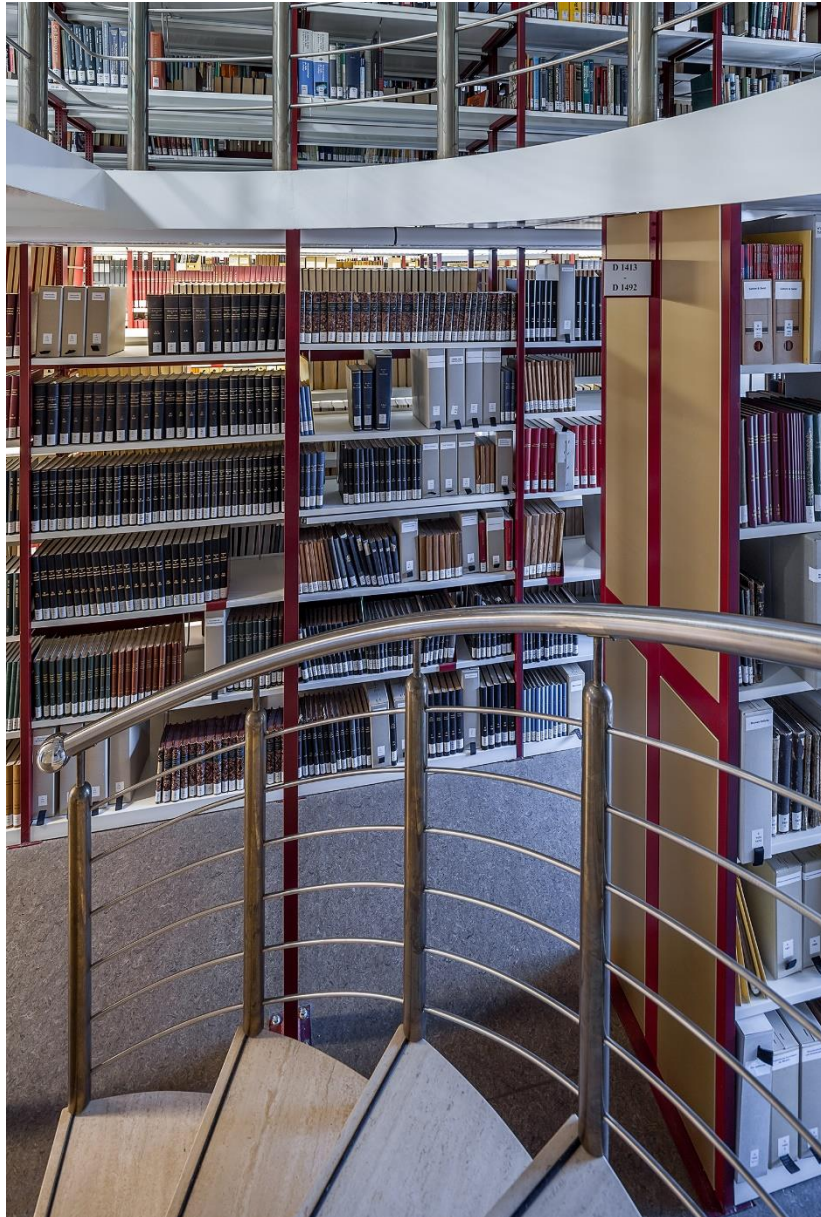


We are in a global race to control and commercialize the management of global knowledge







Holotype, Lectotype, Neotype:  Paratype, etc.:  Holotype & 5 Paratypes: 

The scientific community needs to make an effort to keep the baseline data of its own knowledge open and accessible for everybody



500,000,000+ printed pages
1,900,000 species described
20,000,000+ species treatments
18,000 new species discovered / year

BUT: Data are hidden

-  Incomplete digitization
-  Publications are not semantically enhanced
-  Data are not linked
-  Most data are not open

How can we query our accumulated biodiversity knowledge?



Highly **structured**
research data

publishing



Semantically
unstructured
text

data mining



Semantically
enhanced,
structured data



Lepidium campestre?

Social and behavioral constraints

TreatmentBank: Visualization of data from one article

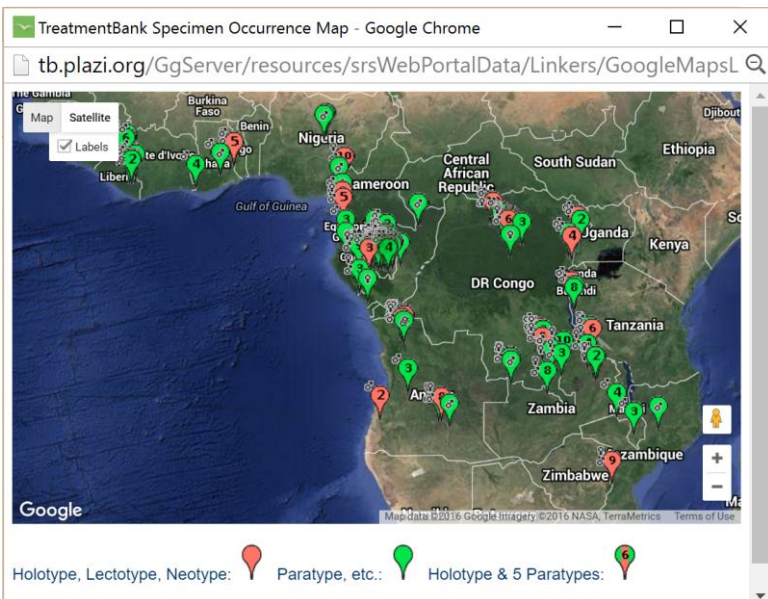


Dijkstra, Klaas-Douwe B., Kipping, Jens & Mézière, Nicolas, 2015, Sixty new dragonfly and damselfly species from Africa (Odonata)

Dijkstra, Klaas-Douwe B., Kipping, Jens & Mézière, Nicolas, 2015, Sixty new dragonfly and damselfly species from Africa (Odonata), *Odonatologica* 44 (4), pp. 447-678

| | |
|---------------------------|---|
| publication ID | http://dx.doi.org/10.5281/zenodo.35388 |
| link to original document | http://dx.doi.org/10.5281/zenodo.35388 |
| document provided by | Donat (2015-12-11 15:22:31, last updated by Admin 2015-12-18 12:58:08) |

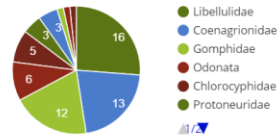
Treatments (61)



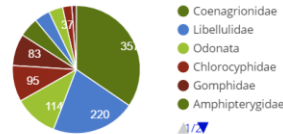
Distribution Map

Specimens

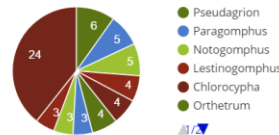
Article: Treatments by Family (n=61)



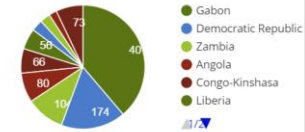
Article: Specimens by Family (n=1034)



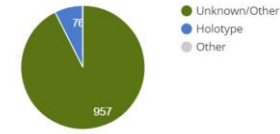
Article: Treatments by Genus (n=61)



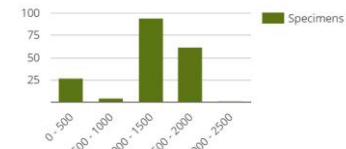
Article: Specimens by Country (n=1034)



Article: Specimens by Type Status (n=1034)



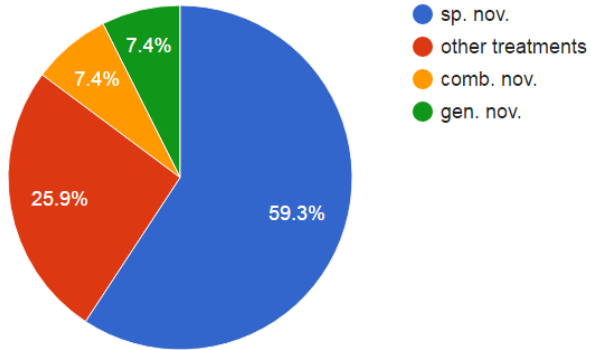
Article: Specimens by Elevation (n=1034)



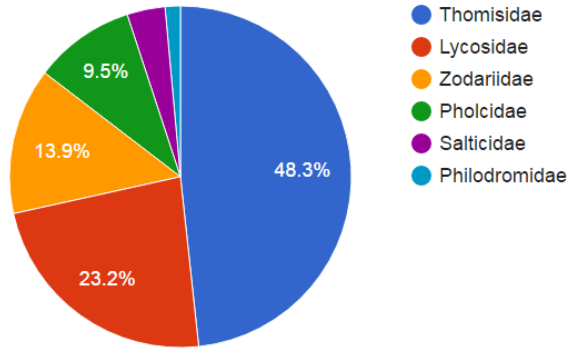
Plazi dashboard

Selected articles published in the European Journal of Taxonomy

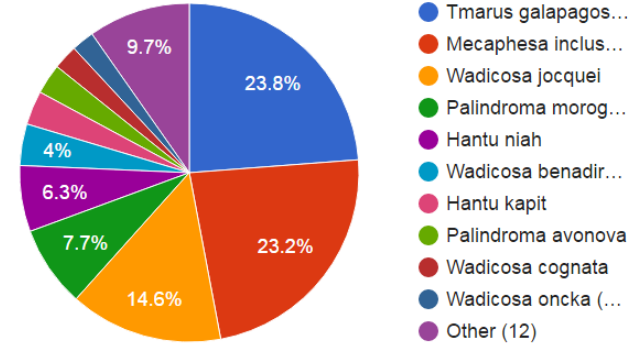
2. Treatments by taxonomic status (n=27)



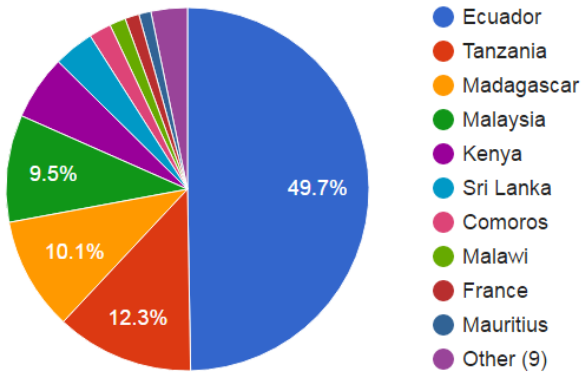
12. Specimens by family (n=555)



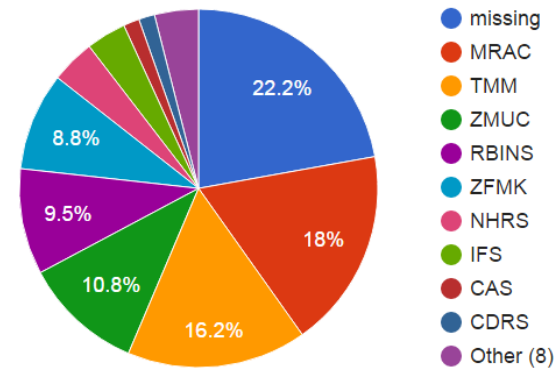
13. Specimens by species (n=555)



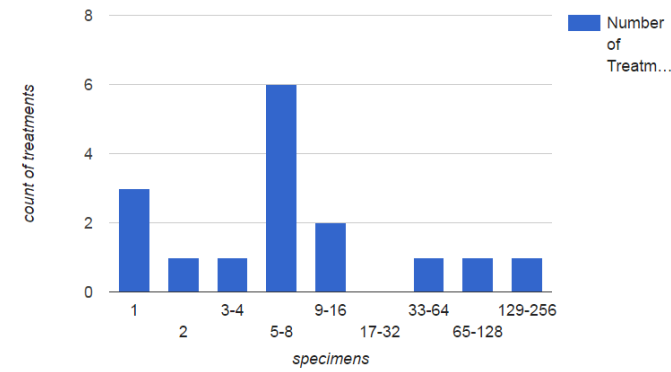
16. Specimens by collecting country (n=555)



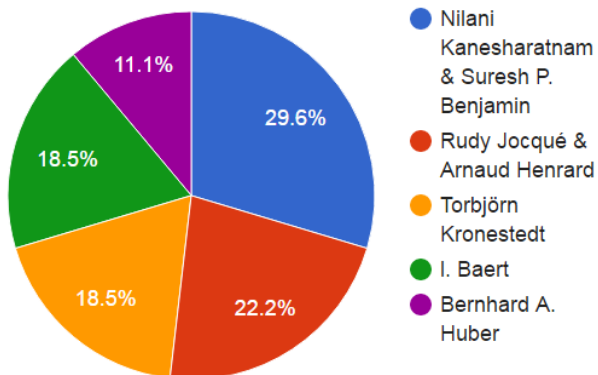
18. Specimens by collection code (n=555)



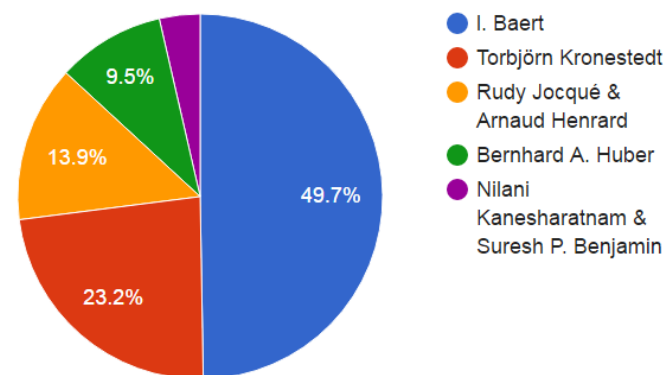
36. New species descriptions: specimens per treatment (n=16)



27. Treatments by author (n=27)



28. Specimens by author (n=555)

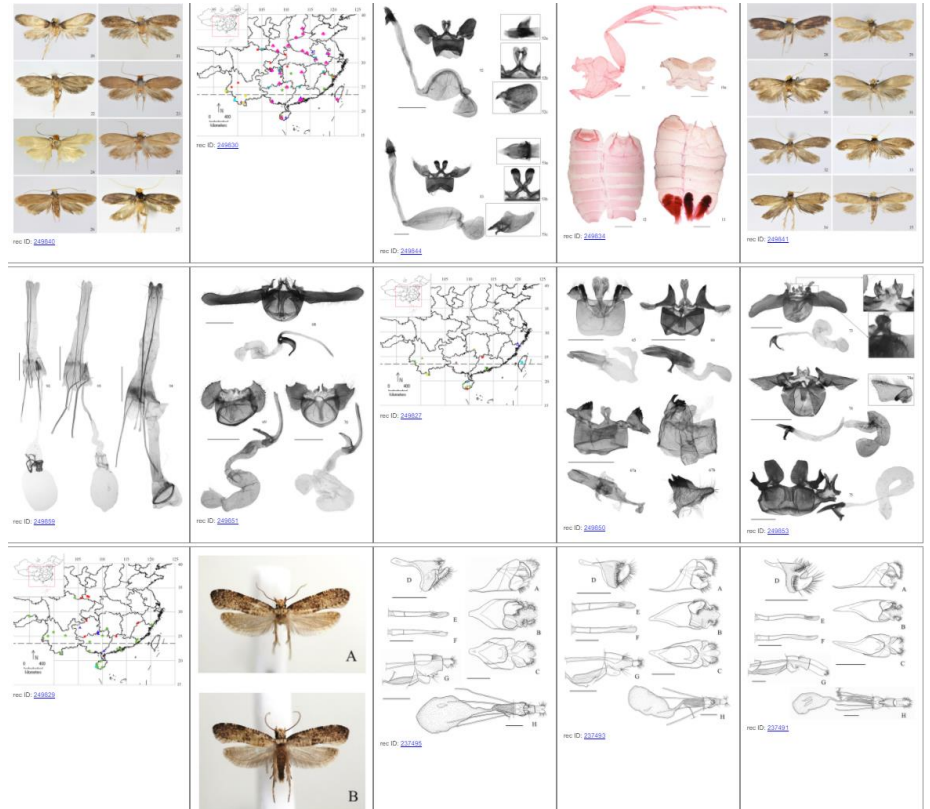
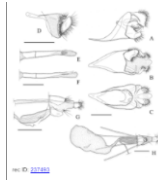




The value of access to subarticle elements: figures



the value of a figure





Biodiversity Data Journal 3: e5707
doi: 10.3897/BDJ.3.e5707



Taxonomic Paper

Utilizing online resources for taxonomy: a cybercatalog of Afrotropical apiocerid flies (Insecta: Diptera: Apioceridae)

Torsten Dikow[‡], Donat Agosti[§]

[‡] National Museum of Natural History, Smithsonian Institution, Washington, DC, United States of America
[§] www.plazi.org, Bern, Switzerland

Corresponding author: Torsten Dikow (dikowt@si.edu)

Academic editor: Daniel Whitmore

Received: 21 Jul 2015 | Accepted: 30 Sep 2015 | Published: 06 Oct 2015

Citation: Dikow T, Agosti D (2015) Utilizing online resources for taxonomy: a cybercatalog of Afrotropical apiocerid flies (Insecta: Diptera: Apioceridae). Biodiversity Data Journal 3: e5707. doi: [10.3897/BDJ.3.e5707](https://doi.org/10.3897/BDJ.3.e5707)

Abstract

A cybercatalog to the Apioceridae (apiocerid flies) of the Afrotropical Region is provided. Each taxon entry includes links to open-access, online repositories such as [ZooBank](#), [BHL/BioStor/BLR](#), [Plazi](#), [GBIF](#), [Morphbank](#), [EoL](#), and a [research web-site](#) to access taxonomic information, digitized literature, morphological descriptions, specimen occurrence data, and images. Cybercatalogs as the one presented here will need to become the future of taxonomic catalogs taking advantage of the growing number of online repositories, linked data, and be easily updatable. Comments on the deposition of the holotype of *Apiocera braunsi* Melander, 1907 are made.

Keywords

cybertaxonomy, open-access, online repositories



Biodiversity Data Journal 3: e5063
doi: 10.3897/BDJ.3.e5063



General Article

Integrating and visualizing primary data from prospective and legacy taxonomic literature

Jeremy A. Miller^{‡,§}, Donat Agosti[§], Lyubomir Penev[|], Guido Sautter[¶], Teodor Georgiev[#], Terry Catapano[§], David Patterson[®], David King[®], Serrano Pereira[‡], Rutger Aldo Vos[‡], Soraya Sierra[‡]

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[§] www.Plazi.org, Bern, Switzerland
[|] Pensoft, Sofia, Bulgaria
[¶] KIT / Plazi, Karlsruhe, Germany
[#] Pensoft Publishers, Sofia, Bulgaria
[®] University of Sydney, Sydney, Australia
[®] The Open University, Milton Keynes, United Kingdom

Corresponding author: Jeremy A. Miller (jeremy.miller@naturalis.nl)

Academic editor: Ross Mounce

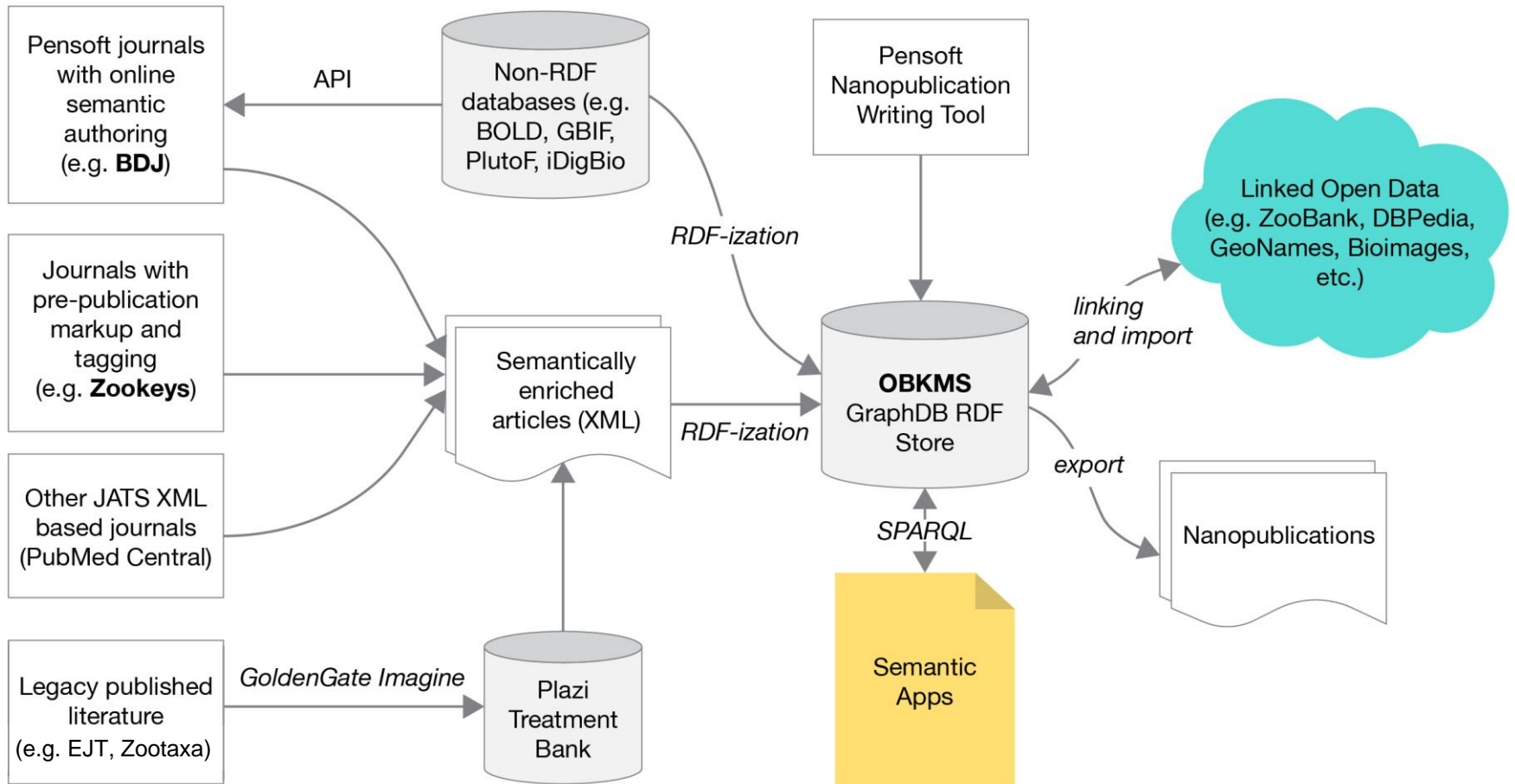
Received: 09 Apr 2015 | Accepted: 06 May 2015 | Published: 12 May 2015

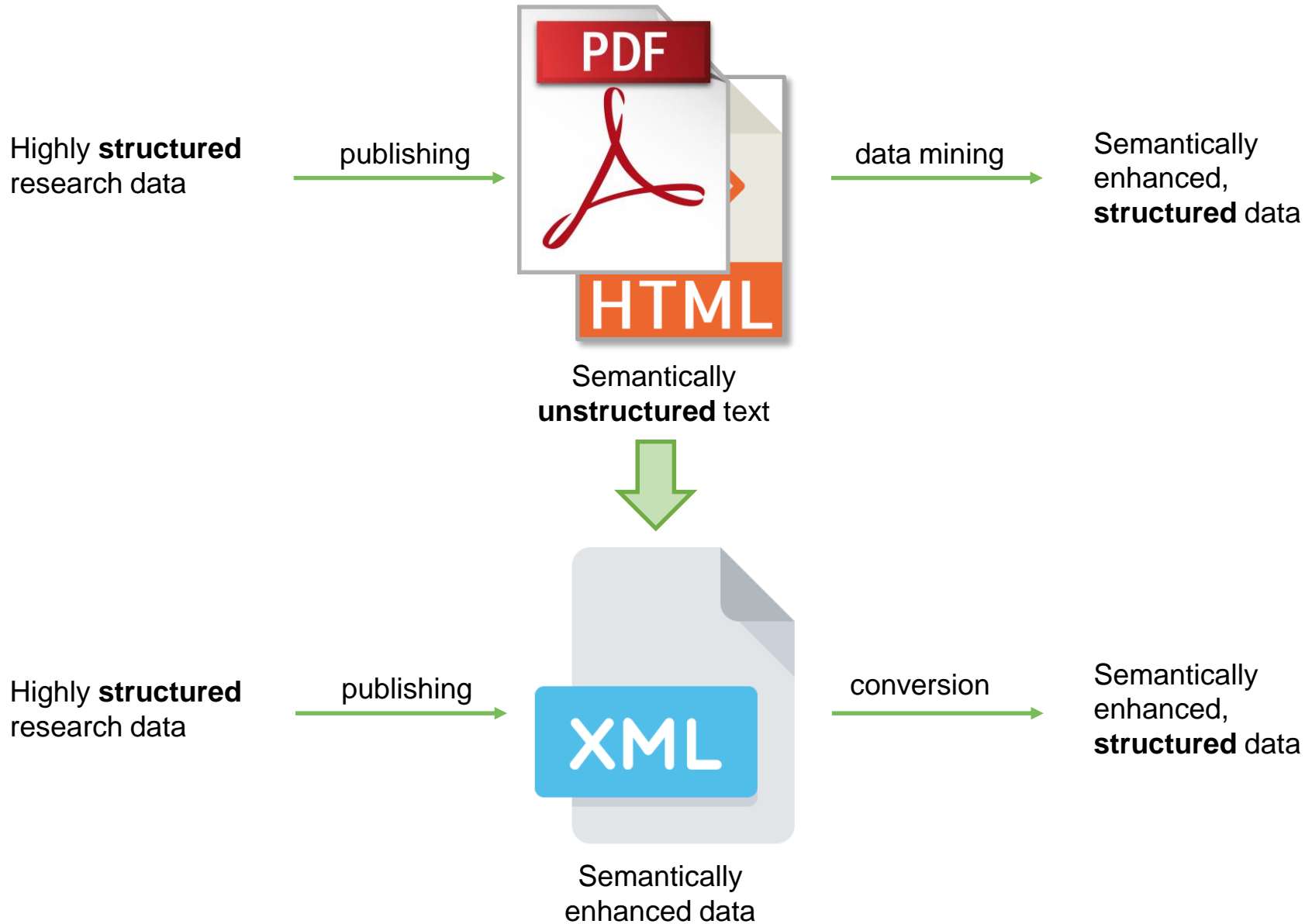
Citation: Miller J, Agosti D, Penev L, Sautter G, Georgiev T, Catapano T, Patterson D, King D, Pereira S, Vos R, Sierra S (2015) Integrating and visualizing primary data from prospective and legacy taxonomic literature. Biodiversity Data Journal 3: e5063. doi: [10.3897/BDJ.3.e5063](https://doi.org/10.3897/BDJ.3.e5063)

Abstract

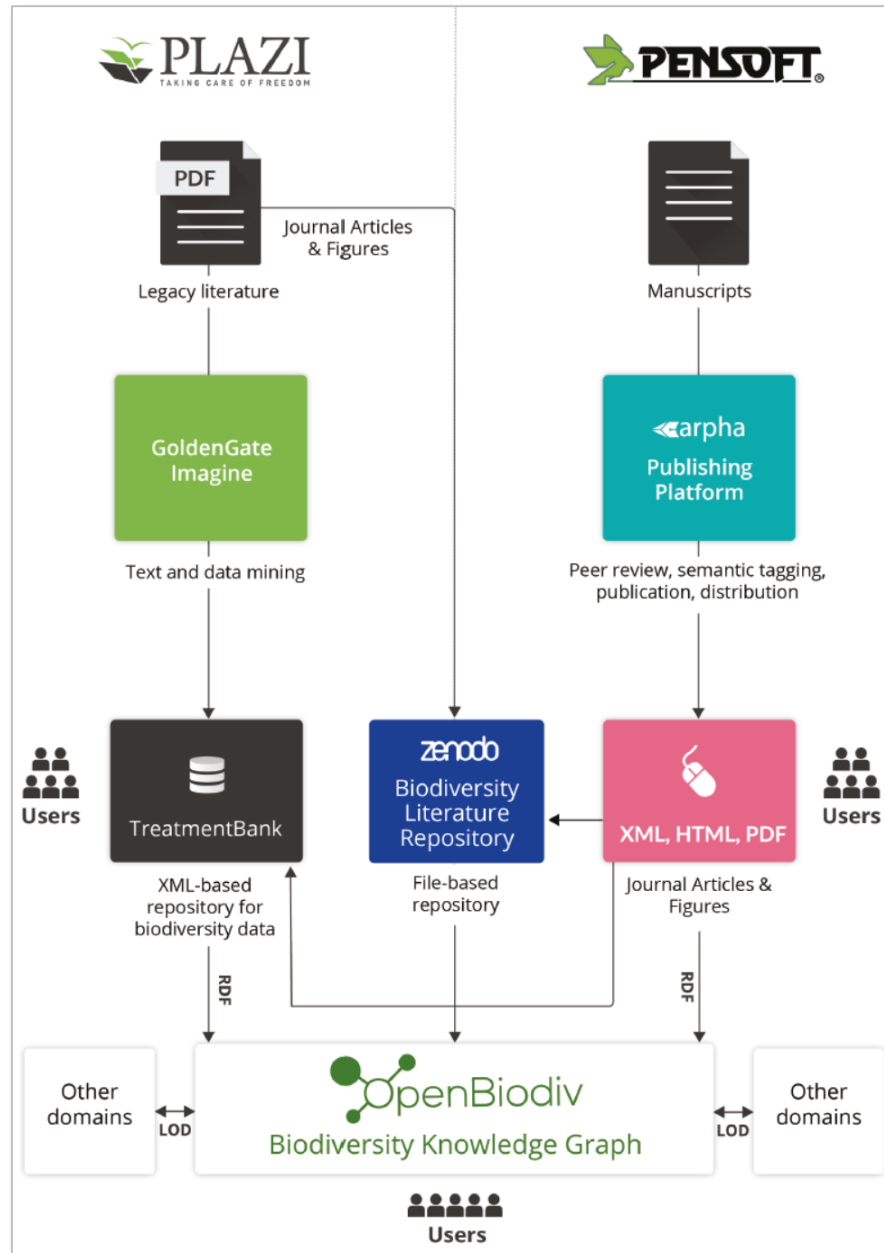
Specimen data in taxonomic literature are among the highest quality primary biodiversity data. Innovative cybertaxonomic journals are using workflows that maintain data structure and disseminate electronic content to aggregators and other users; such structure is lost in traditional taxonomic publishing. Legacy taxonomic literature is a vast repository of knowledge about biodiversity. Currently, access to that resource is cumbersome, especially for non-specialist data consumers. Markup is a mechanism that makes this content more accessible, and is especially suited to machine analysis. Fine-grained XML (Extensible Markup Language) markup was applied to all (37) open-access articles published in the journal Zootaxa containing treatments on spiders (Order: Araneae). The markup approach was optimized to extract primary specimen data from legacy publications. These data were combined with data from articles containing treatments on spiders published in Biodiversity Data Journal where XML structure is part of the routine publication process. A series of charts was developed to visualize the content of specimen data in XML-tagged taxonomic treatments, either singly or in aggregate. The data can be

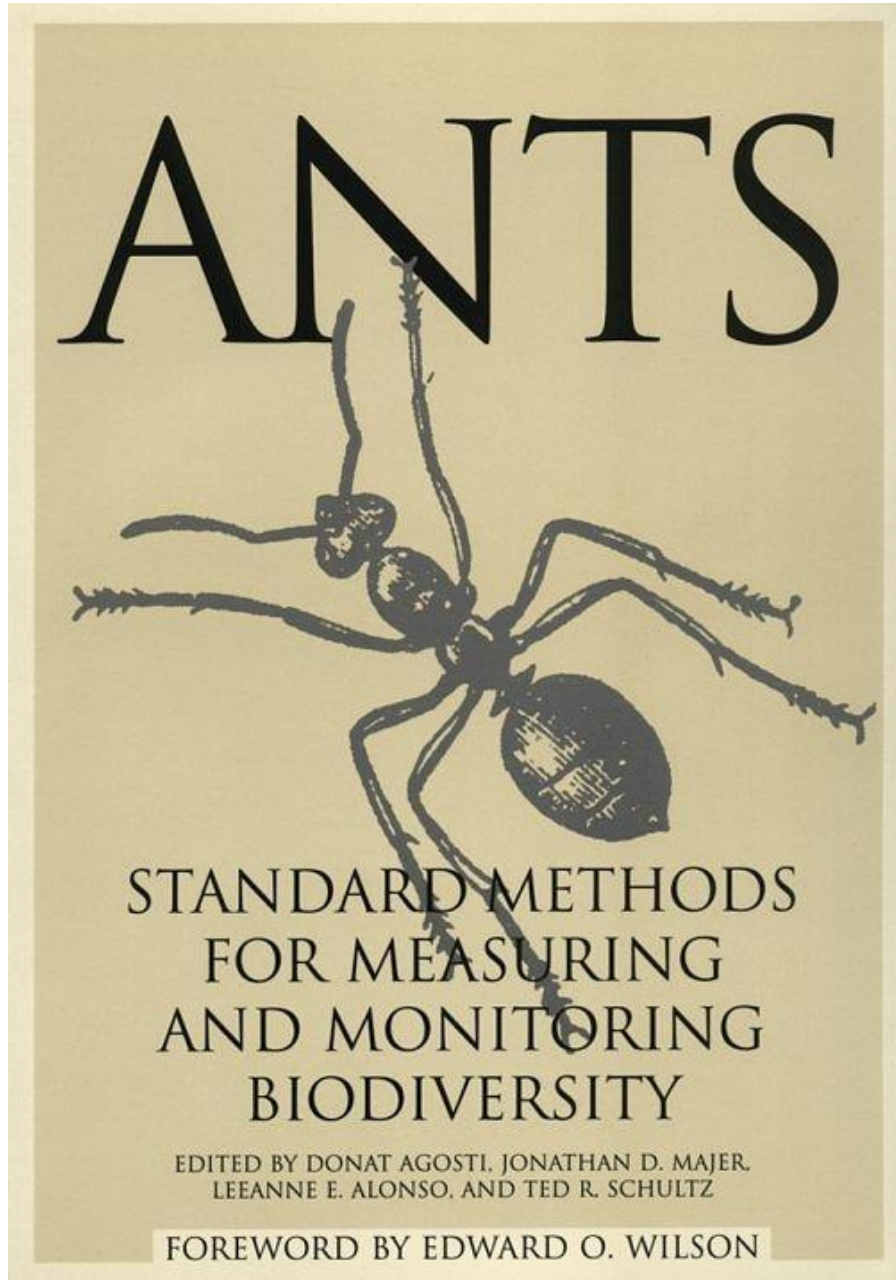
The Open Biodiversity Knowledge Management System (OpenBiodiv)





The future will be open, semantically enhanced publishing





How many species are there on planet Earth?

Compare biodiversity over space, time, habitat and land use change

- What organism is it?
- What do I know about it?
- Where does it live?

1995: Idea

1996: NSF funded workshop

2000: SI-Press published

2018: >2,500 citations

The use of *Open Access* scholarly articles



Before antbase.org, Harvard's Museum of Comparative Zoology could claim to be the only location with a complete set of ant systematics publications from 1758 - present.



**Online library,
2000 onwards**



109775 visits from 28 Aug 2006 to 29 Aug 2007
' distance in which individuals are clustered
Total number of visits depicted above = 109457
Dot sizes:
● = 1000 + ● = 100 - 999 ● = 10 - 99 ◆ = 1 - 9

Antbase and **NMNH** through support from the **Atherton-Seidal foundation** opened up the entire ant taxonomic literature – and it has been used by a global community



From an article to treatments

Online catalogue
Open access
Online library
«Linked data»
2004



Hymenoptera Name Server

version 1.5 19.xii.2007

Results for the species *Anochetus Grandidieri* Forel:

Classified in: Vespoidea: Formicidae: Ponerinae: Ponerini: *Anochetus*

Status of name: Invalid, Original name/combination

Valid name: *Anochetus grandidieri* Forel

Date of description: 1891

Described by: Forel, page(s) 108.

Citation of original description:

- [Forel, A.](#) 1891. Histoire naturelle des hyménoptères. Les formicides. Histoire Physique, Naturelle et Politique de Madagascar 20(2): 1-280.

HYMENOPTERA ONLINE (HOL)

The order Hymenoptera contains some 115,000 species and millions of specimens in collections around the world. Our goal is to provide access to these data. Some parts of this database have extensive information available (e.g., Proctosporinae, Polistogastera, Campoplexinae, Apoidea), even to the level of specimens (see that over index, [specimens](#), [Hymenoptera](#), [Formicidae](#)), with labor contributions by Joe Cunn. The HOL data portal was designed and implemented by Joe Cunn. The data themselves have been gathered with the collaboration of a number of colleagues. A number of files still need work. HOL is no longer solely dedicated to Hymenoptera as recent acquisitions have expanded the taxonomic scope of this resource to include Ichneutinae, Cynipidae, Hymenoptera, Hymenoptera, and others with the help of a number of tireless collaborators. If you would like to contribute to the further development and enhancement of this resource or need technical assistance related to Hymenoptera Online services, please contact HOL Help, [Hymenoptera](#) or the HOL Google Page.

Search for taxa, collections, authors, collectors and specimens by typing your simple query in the text box below. Taxon name searches are case-sensitive and a wildcard (*) will automatically be appended to the end of your query (e.g. *Trichogramma*), the same applies to collectors and authors (e.g. *Smith*), collectors (e.g. *CICG*), genera (e.g. *Ichneutinae*), journals (e.g. *Hymenoptera*), and specimen searches by specimen ID (e.g. *AMNH 92.22*).

If you would like to see a list of new features, recent changes and recent additions to Hymenoptera Online, visit the [HOL Google Page](#). For basic site statistics and archived updates, browse the [updates page](#). Visit the [collection page](#) for the C.A. Triplehorn Insect Collection at the Ohio State University for information on its primary and secondary type holdings as well as database files in the collection.

Search:

Reference: Forel, 1891. Histoire naturelle des hyménoptères. Les formicides. Histoire Physique, Naturelle et Politique de Madagascar 20(2): 1-280 - view extended reference

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Current: < 108 > "

108 MADAGASCAR.

2. ANOCHETUS GRANDIDIERI, n. sp.
(Pl. III, fig. 9, 9', 9" et 9'.)

♂. Longueur 4 mill. Voisin des *A. rectangularis*, Mayr, et *A. Mayri*, Emery, dont il est du reste facile à distinguer. Mandibules à bord interne sans trace de dentelures, passant presque sans angle à la dent terminale supérieure. Elles se terminent par deux dents très courtes et très obtuses (cependant il est possible que ce soit l'effet de l'usure chez l'exemplaire unique, et que chez les jeunes ♀ les dents soient longues et pointues. Dans ce cas, il se pourrait qu'il existe une troisième petite dent médiane se détachant de la dent inférieure vers son milieu, comme chez

Treatment citation

Taxonomic treatment



Special aspects of taxonomic publications:

Highly standardized in language and representation
Publications as container of citations and data



Taxonomic treatment

Formica obsoleta Linnaeus, 1758: 580

name

obsoleta. 5. F. supra nigra, subtus testaceo rufa, abdomine subglobofo.

Habitat in Europæ terra.

description

distribution

Each taxonomic name usage has it's treatment

Linnaeus has to be credited for Latin Binomen AND **taxonomic treatment**.



Oxyscelio carinatus (Kieffer)

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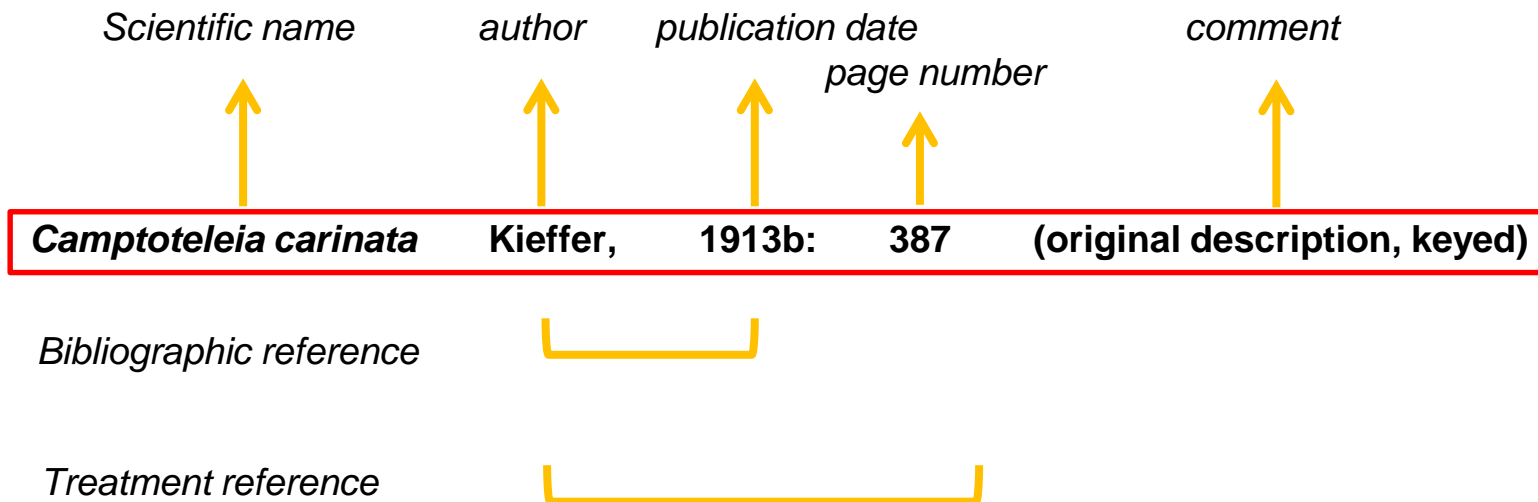
http://species-id.net/wiki/Oxyscelio_carinatus

Figures 82–87; Morphbank⁴⁰

Camptoteleia carinata Kieffer, 1913b: 387 (original description, keyed); Kieffer 1914: 296 (keyed); Kieffer 1916: 171 (keyed); Kieffer 1926: 380 (description, keyed).

Oxyscelio carinatus (Kieffer): Dodd 1931: 74 (generic transfer); Masner 1976: 23 (type information).

Camptoteleia kiefferi Benoit: Kelner-Pillault 1958: 150 (unnecessarily proposed replacement name, rejected by Baltazar (1966)).





Profundiconus puillandrei sp. nov.

[urn:lsid:zoobank.org:act:55807BF8-D984-42C1-B039-F3EBD8EB2C13](https://doi.org/10.55807/BF8-D984-42C1-B039-F3EBD8EB2C13)

Figs 12A–J, 13A–D, 14

Conus ikedai – Poppe 2008: pl. 615, fig. 1a–b (non *C. ikedai* Ninomiya, 1987).

Conus smirna – Marshall 1981: 499, fig. 3j (non *C. smirna* Bartsch & Rehder, 1943).

Conus sp. C – Röckel *et al.* 1995b: 585, fig. 49.

Profundiconus n. sp. g. – Puillandre *et al.* 2014: Supplementary Material 1 (unfigured).

Etymology

This new species is dedicated to Dr. Nicolas Puillandre, mollusc curator at the MNHN. Dr. Puillandre has a long and outstanding trajectory in the study of the phylogeny of the Conoidea. The naming of the new species after him recognises his important contributions to the taxonomy of Conoidea at the molecular level.

Type material examined

Holotype

NEW CALEDONIA: 43.2 × 18.0 mm, R/V *Alis*, NORFOLK 1 Expedition, st. DW 1707, Banc Jumeau Est, Norfolk Ridge, 23°43' S, 168°16' E, 381–493 m (MNHN IM-2000-30771; Fig. 12A).

Paratypes

NEW CALEDONIA: 39.6 × 17.3 mm, R/V *Alis*, NORFOLK 2 Expedition, st. DW 2072, Banc Aramis, Norfolk Ridge, 25°21' S, 168°57' E, 1000–1006 m (MNHN IM-2000-30772; paratype 1; Fig. 12B);



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Cataglyphis turcomanicus (Emery)

Agosti, Donat. 1990. Review and reclassification of Cataglyphis (Hymenoptera, Formicidae). Journal of Natural History 24, pp. 1457-1505: 1490

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| scientific name | Cataglyphis turcomanicus (Emery) |
| status | |

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Taxonomy

| | |
|---------|-------------|
| Kingdom | Animalia |
| Phylum | Arthropoda |
| Class | Insecta |
| Order | Hymenoptera |
| Family | Formicidae |
| Genus | Cataglyphis |

Timeline:

- 1898: Myrmecocystus turcomanica (Emery 1898)
- 1920: Cataglyphis bicolor var. turcomanica (Crawley 1920: 177)
- 1925: Cataglyphis (Cataglyphis) bicolor ssp. setipes var. turcomanica (Emery 1925)
- 1929: Cataglyphis (Cataglyphis) bicolor st. setipes var. turcomanica (Santschi 1929: 49)
- 1964: Cataglyphis turcomanica (Arnoldi 1964)
- 1990: Cataglyphis turcomanicus (Emery) (Agosti, Donat 1990)

Specimens

Downloads

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Cataglyphis turcomanicus (Emery)

Taxonomy

Ag Hi p

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scientific name *Cataglyphis turcomanicus* (Emery)

status

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Treatment

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| | |
|--------|-------------|
| Order | Hymenoptera |
| Family | Formicidae |
| Genus | Cataglyphis |

1990 Agosti, Donat

1964 turcomanica Arnoldi

1929 Cataglyphis (Cataglyphis) bicolor st. setipes var. turcomanica Santschi

1925 Cataglyphis (Cataglyphis) bicolor ssp. setipes var. turcomanica Emery

1920 Cataglyphis bicolor var. turcomanica Crawley

1898 Myrmecocystus turcomanica Emery

Specimens

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Materials citation: linking to the digital object of the cited specimen



Profundiconus puillandrei sp. nov.

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Figs 12A–J, 13A–D, 14

- Conus ikedai* – Poppe 2008: pl. 615, fig. 1a–b (non *C. ikedai* Ninomiya, 1987).
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Norfolk Ridge, 25°21' S, 168°57' E, 1000–1006 m (MNHN IM-2000-30772; Fig. 12B).

MNHN-IM-2007-30772

28



🏠 / MNHN / Molluscs (IM) / 2007-30772

Conus frigidus Reeve, 1848



From a taxonomic treatment
to a material citation
to the digital object

European Journal of Taxonomy:
DOI: [10.5852/ejt.2016.173](https://doi.org/10.5852/ejt.2016.173)
Treatment:

SPECIMEN

ALCOOL95 MNHN-IM-2007-30772
Size 37.3

MNHN-IM-2007-30772

TAXONOMY

Phylum Mollusca
Class Gastropoda
Order Neogastropoda
Family Conidae
Genus *Conus*
Species *Conus frigidus*
Name *Conus frigidus* Reeve, 1848

ORIGIN

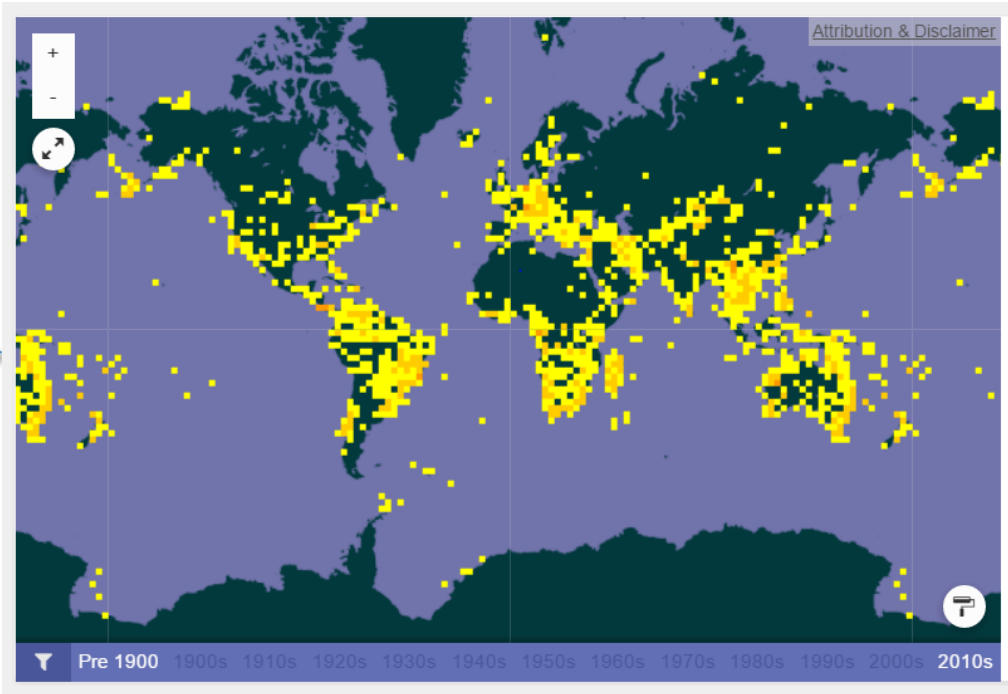
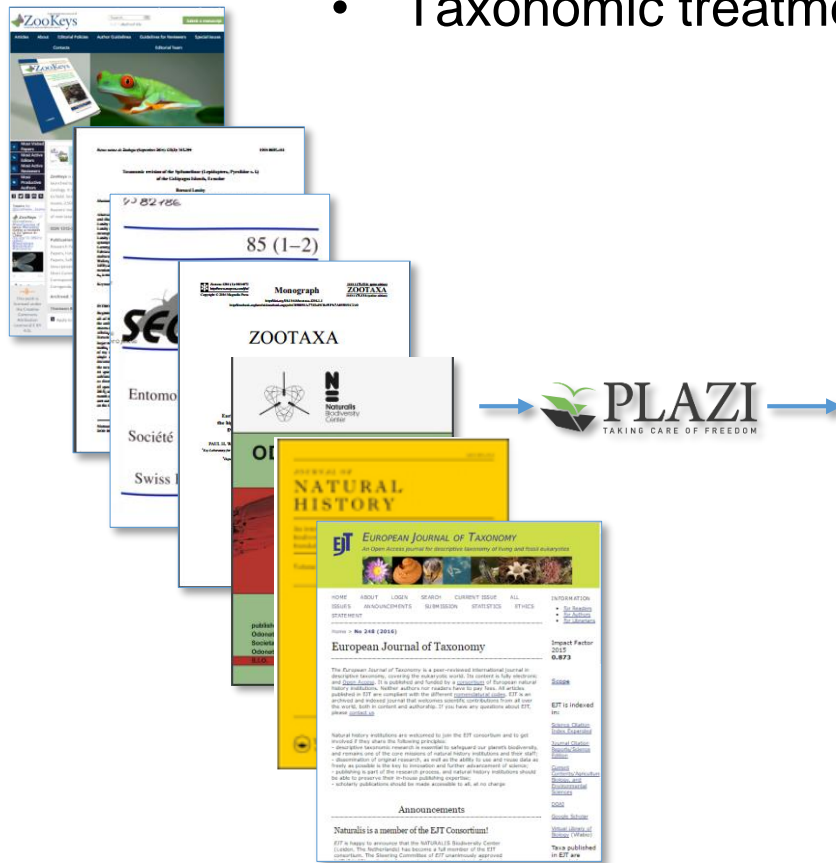
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📅 Expedition SANTO 2006
Station number VM02
Collection date 2006-09-10
Depth (meters) 0-1
📍 Geographic 15° 34' 51.9996" S ; 167° 2' 23.5248" E





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- Observation records: 64,651
- Observation records geo-referenced: 25761
- Taxonomic names: 159,983
- Taxonomic treatments: 173,245



GBIF

<http://www.gbif.org/publisher/7ce8aef0-9e92-11dc-8738-b8a03c50a862>

Long tail: major contribution towards little known, rare and recently discovered species

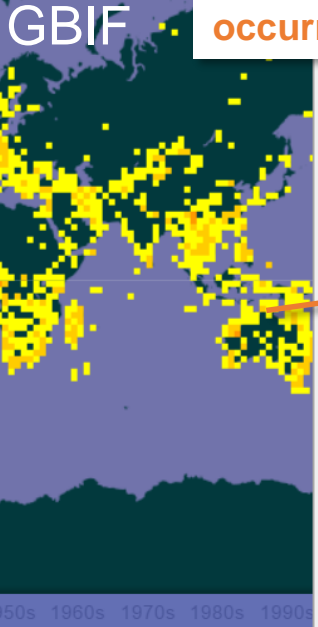
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Occurrence

treatment

article



occurrence

GBIF Global Biodiversity Information Facility

640C879FFFEA1D13FF318294FF9DF86A
Specimen of *Cytaea sinuata* (Döleschall, 1859) recorded on May 1, 1996
from 'Redescription of four species of *Cytaea* Keyserling, 1882 (Araneae: Salticidae)' dataset.

Information Verbatim

ISSUES

Geodetic datum assumed WGS84

GEOGRAPHIC CLASSIFICATION
Australia

Identification details According to GBIF Backbone Taxonomy

IDENTIFIED AS SPECIES
Cytaea sinuata (Döleschall, 1859)

TAXONOMIC CLASSIFICATION
Animalia › Arthropoda › Arachnida › Araneae › Salticidae › Cytaea

Occurrence details

RECORDED
May 1, 1996 2:00:00 AM by D. Knowles & F. Knowles

INDIVIDUAL COUNT
2

SEX
Male

Source details

DATA PUBLISHER
Plazi.org taxonomic treatments database

Record details on publisher site

DATA SET
Redescription of four species of *Cytaea* Keyserling, 1882 (Araneae: Salticidae)

COLLECTION CODE
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OCCURRENCE ID
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Cytaea sinuata (Döleschall, 1859)

Trębicki, Łukasz, Patoleta, Barbara M. & Gardzińska, Joanna, 2016, Redescription of four species of *Cytaea* Keyserling, 1882 (Araneae: Salticidae), *Zootaxa* 4189 (2), pp. 378-386: 383-385

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scientific name
Cytaea sinuata (Döleschall, 1859)

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Monograph

ISSN 1076-9702
ZOOTAXA
ISSN 1076-9702

<http://dx.doi.org/10.11646/zootaxa.4189.2.11>

ZOOTAXA

4204

Early-diverging bumblebees from across the roof of the world:
the high-mountain subgenus *Megadictyon* revised from species'
gene coalescences and morphology (Hymenoptera, Apidae)

PAUL H. WILLIAMS¹*, HAXING HUANG², PIERRE RASHMONT³ & BANGDONG AN⁴

¹Key Laboratory for Grassland Pastoral Biology of the Ministry of Agriculture, Institute of Agricultural Research, Chinese Academy of Agricultural Sciences, Beijing 100081, China

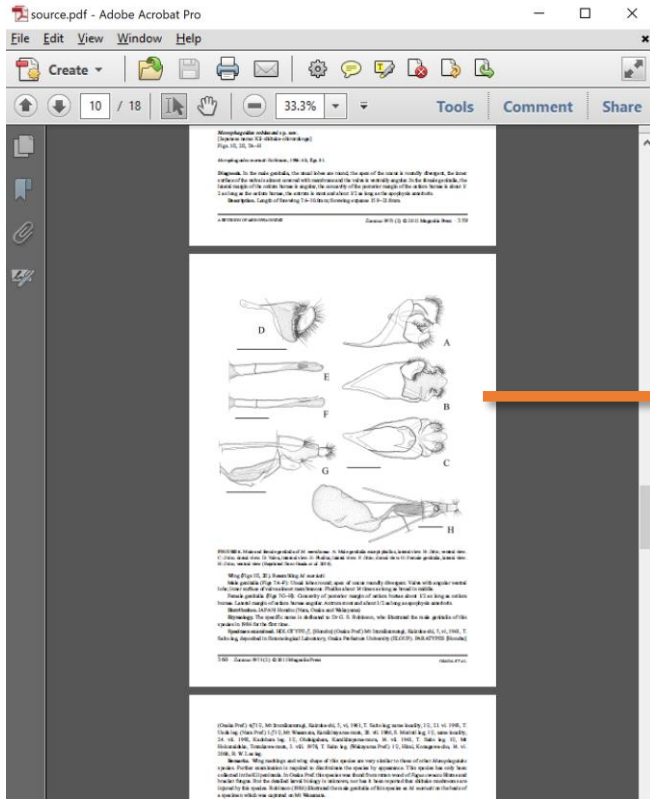
²Department of Life Sciences, The Natural History Museum, Cromwell Road, London SW7 2BD, U.K.

³Collection of Zoology, University of Bonn, Ponsstr. 20, D-53115 Bonn, Germany

⁴Corresponding author. E-mail: paul.williams@caas.ac.cn

Magnolia Press
Auckland, New Zealand

Accepted by T. Claxton 17 Dec 2016; published 22 Dec 2016



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December 31, 2015

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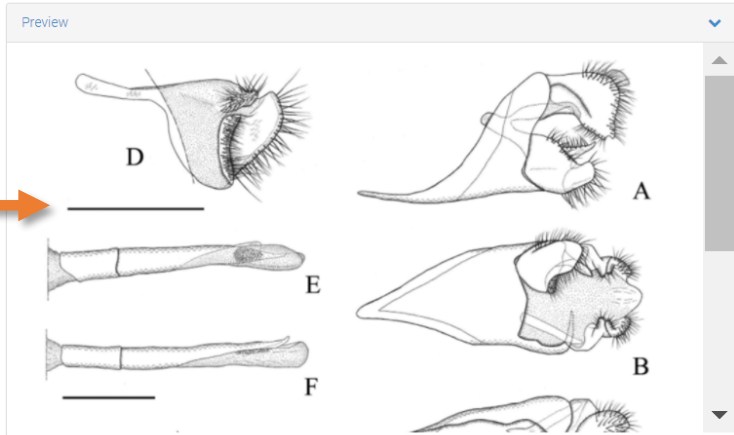
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FIGURE 6 in A revision of the genus *Morphogoides* Petersen (Lepidoptera, Tineidae) from Japan

Osada, Yohei; Sakai, Makoto; Hirowatari, Toshiya

FIGURE 6. Male and female genitalia of *M. meridianus*. A: Male genitalia except phallus, lateral view. B: Ditto, ventral view. C: Ditto, dorsal view. D: Valva, internal view. E: Phallus, lateral view. F: Ditto, dorsal view. G: Female genitalia, lateral view. H: Ditto, ventral view (Reprinted from Osada et al. 2014).



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DOI: [10.5281/zenodo.237493](https://doi.org/10.5281/zenodo.237493) DOI

Biodiversity Taxonomy Animalia Arthropoda
Insecta Lepidoptera Tineidae Morphogoides

Related identifiers:
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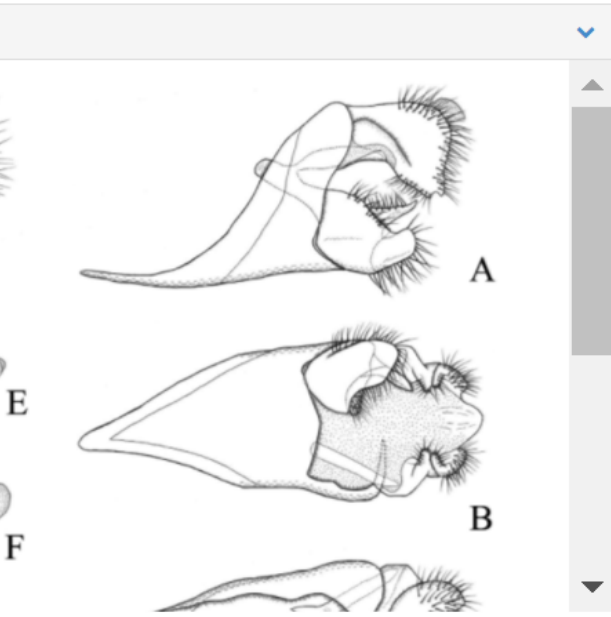
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tersen (Lepidoptera,
an

enus. A: Male genitalia except phallus, lateral view. B: Ditto, ventral view. C:
s, lateral view. F: Ditto, dorsal view. G: Female genitalia, lateral view. H:
14).



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Publication date:
December 31, 2015

DOI:
DOI [10.5281/zenodo.237493](https://doi.org/10.5281/zenodo.237493) DOI

Keyword(s):
Biodiversity Taxonomy Animalia Arthropoda
Insecta Lepidoptera Tineidae Morphogoides

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Davlatov, Abdulaziz M.; Wu, Chun-Sheng

Davlatov, Abdulaziz M., Wu, Chun-Sheng (2018): Description of a new species of the genus *Caeneressa* from China, with a checklist of the genus (Lepidoptera: Erebidae). *Zootaxa* 4374 (2): 294-300, DOI: <https://doi.org/10.11646/zootaxa.4374.2.9>

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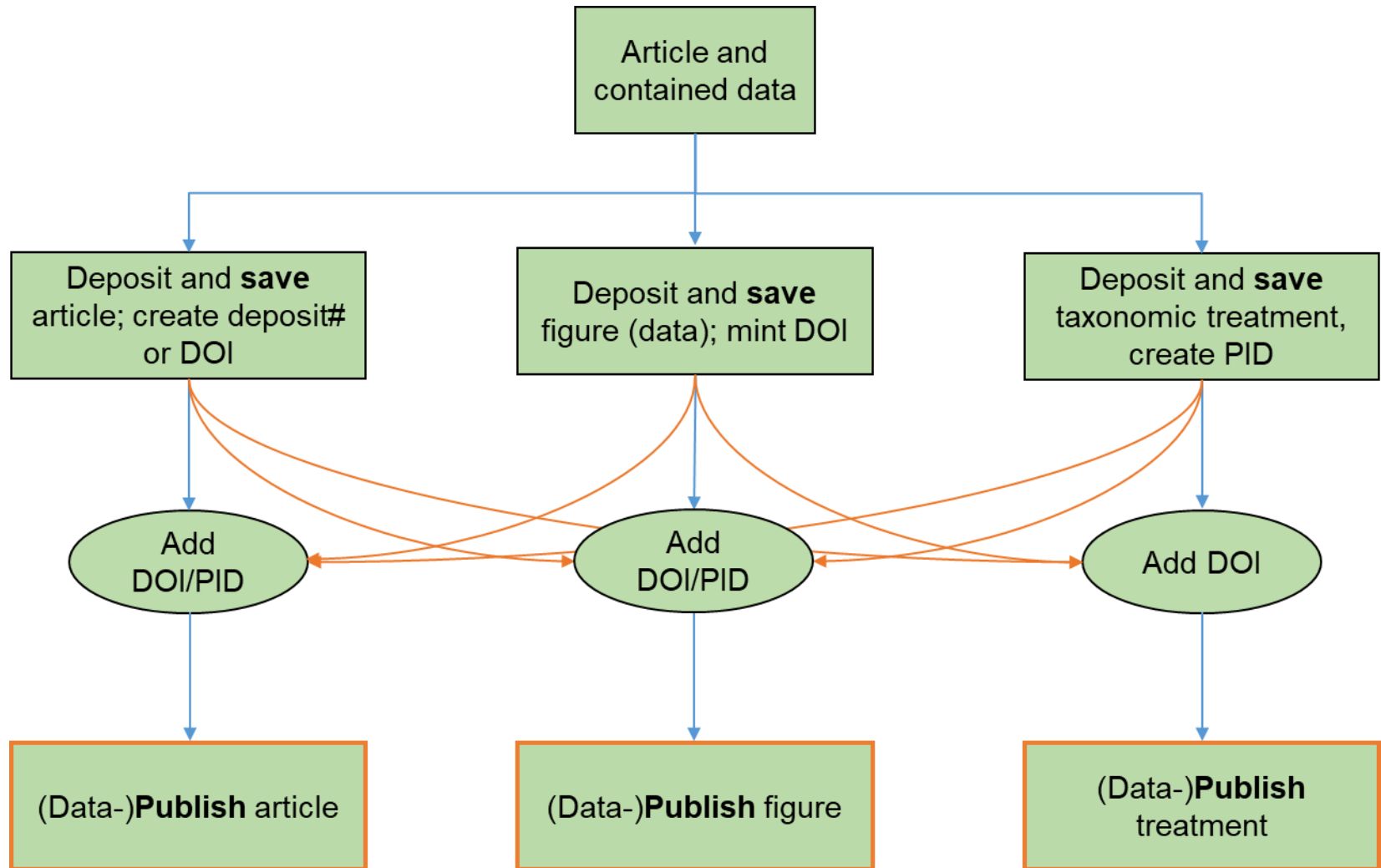
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Biodiversity Taxonomy Animalia Arthropoda
Insecta Lepidoptera Erebidae

Published in:
Zootaxa: 4374 pp. 294-300.

Related identifiers:
Cites:
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[10.1080/00222939808677944](https://doi.org/10.1080/00222939808677944),
[10.5635/ASED.2014.30.1.033](https://doi.org/10.5635/ASED.2014.30.1.033), [10.1111/j.1365-2311.1889.tb02699.x](https://doi.org/10.1111/j.1365-2311.1889.tb02699.x), [10.5962/bhl.part.13691](https://doi.org/10.5962/bhl.part.13691),
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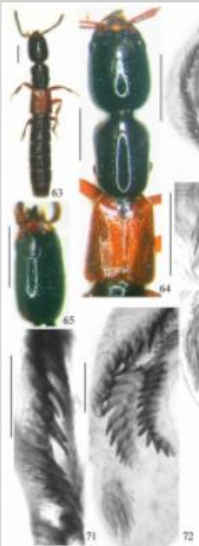
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Phrynonoponera pulchella Bolton & Fisher, Bolton, B. & Fisher, B. L., 2008

Bolton, B. & Fisher, B. L., 2008, The Afrotropical ponerine ant genus *Phrynonoponera* Wheeler (Hymenoptera: Formicidae), Zootaxa 1892, pp. 35-52: 47-49

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| treatment provided by | Christiana (2009-08-06 00:05:20) |
| scientific name | <i>Phrynonoponera pulchella</i> Bolton & Fisher |
| status | sp. n. |

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Treatment

Phrynonoponera pulchella Bolton & Fisher ^{HNS} ^{Edit} sp. n. ^{Edit}

(Figures 5a-d) Holotype worker. TL 11.1, HL 2.48, HW 2.56, CI 103, SL 2.04, SI 80, PW 2.04, WL 3.76, maximum diameter of eye 0.56, OI 22. ^{Edit}

Mandible smooth with scattered setal pits, with 5 teeth, the basal tooth no more than a broad angle. Median portion of anterior clypeal margin with a small and extremely shallow median indentation which rounds broadly and evenly into the clypeal margin on each side; without a prominent tooth on each side of the midline. Dorsum of head near midline very finely and very densely rugulose, the narrow rugulae predominantly longitudinal but with some fine anastomoses; spaces between rugulae extremely finely reticulate-punctate to shagreenate. More laterally on cephalic dorsum, and behind the eyes, the reticulae are wider though no more strongly defined. Dorsum of mesosoma coarsely, irregularly reticulate-rugose, spaces between reticulae shagreenate. Metanotal groove in dorsal view visible laterally but obliterated towards central area of dorsum. Median strip of propodeal dorsum with pubescence that is much more dense than anywhere else on dorsum of mesosoma. Propodeal teeth in dorsal view short, broad at base and blunt apically. Petiole broad, width at base of spines ca. 2.00, surmounted by 5 spines that are all short and stout. Outer pair of petiolar spines the longest, broadly triangular and weakly divergent. Median spine only slightly longer than the flanking pair. Gastral tergites 1-3 shagreenate to extremely finely and densely reticulate-punctate, with scattered larger setal pits; tergites also densely clothed with subappressed to appressed pubescence. Setae on first gastral tergite suberect to subdecumbent, short, maximum length ca. 0.22. ^{Edit}

Paratype workers. TL 11.5-12.0, HL 2.40-2.48, HW 2.40-2.62, CI 100-106, SL 1.92-2.04, SI 78-80, PW 1.88-1.96, WL 3.44-3.68, maximum diameter of eye 0.56-0.58, OI 22-23 (3 measured). As holotype but mandible with 3-5 teeth. In one specimen the left mandible has 5 teeth, the right mandible 3. ^{Edit}

Holotype worker. Kenya: Kora Res., Tana River, 22.vii.1983, 0-100 m., no. 5c, Acacia-Commiphora scrub (N.M. Collins & M. Ritchie) (BMNH). ^{Edit}

Paratypes: 9 workers (2 dissected, on same pin), with the same data (BMNH, CASC). ^{Edit}

Current View: All Antweb

Cite this page

Specimen: CASENT0900674 *Phrynonoponera pulchella* ⁺ ⁺ Overview | Images

Classification: Order: Hymenoptera Family: Formicidae Subfamily: Ponerinae Genus: *Phrynonoponera* Species: *pulchella* Specimen: CASENT0900674

Persistent Identifier:

<https://www.antweb.org/specimen/CASENT0900674>

Locality Information:

Biogeographic Region: **Afrotropical**
 Locality: **Kenya: Kora Reserve, Tana River, no 5c**
 Latitude: **0.0**
 Longitude: **0.0**
 Lat/Long Max Error:
 Elevation **50 m**
 Elevation Max Error:
 Locality Notes:

Collection Information:

Collection code: **ANTC19776**
 Collected by: **NM. Collins, M. Ritchie**
 Date collected: **22 Jul 1983**
 Date collected end:
 Habitat:
 Method:
 Microhabitat:
 Collection notes:

Specimen Information:

Life stage: **w**
 Located at: **BMNH**
 Owned by: **BMNH, London, U.K.**
 Determined by: **B. Bolton**
 Date determined: **31 Dec 2008**
 Type status: **■ Holotype of *Phrynonoponera pulchella***





Species: *Phrynoponera pulchella* Bolton & Fisher, 2008 [Overview](#) | [Specimens](#) | [Images](#) | [Map](#)

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Classification: Order: Hymenoptera Family: Formicidae Subfamily: Ponerinae Genus: *Phrynoponera* Species: *pulchella*

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Taxonomic History (provided by Barry Bolton, 2016)

Phrynoponera pulchella Bolton & Fisher, 2008B PDF: 47, figs. 5a-d (w.) KENYA. Afrotropic. AntCat AntWiki HOL

Distribution:

Afrotropical Region: Kenya, Tanzania

Distribution Notes:

specimen CASENT0178203 and CASENT0178204 on AntWeb

Taxonomic Treatment (provided by Plazi)

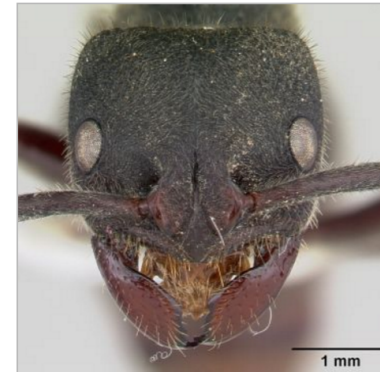
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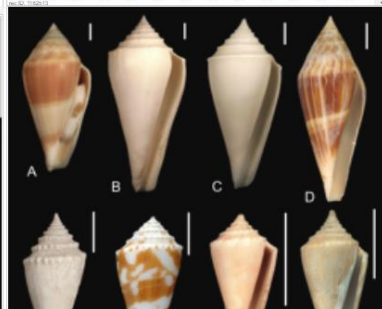
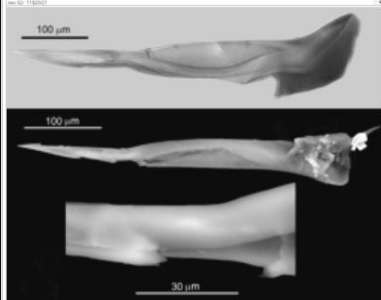
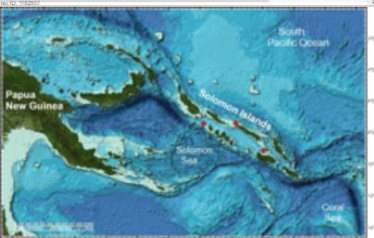
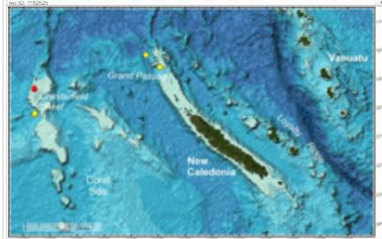
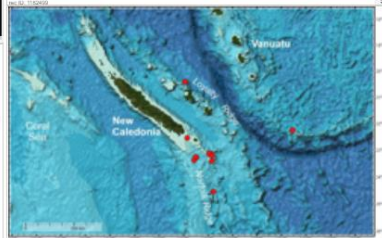
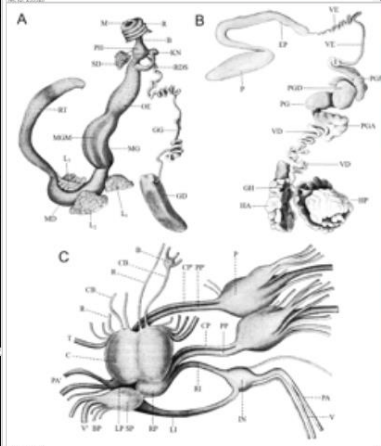
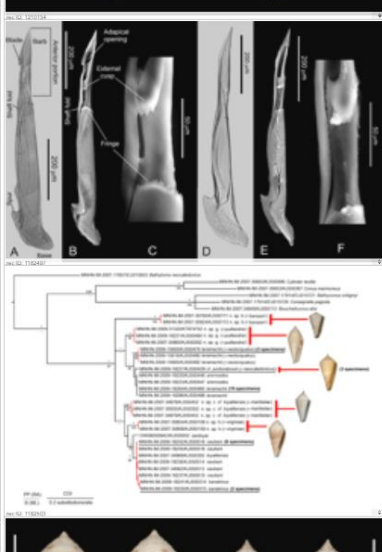
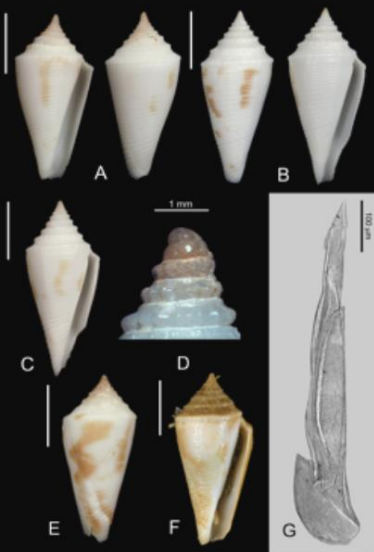
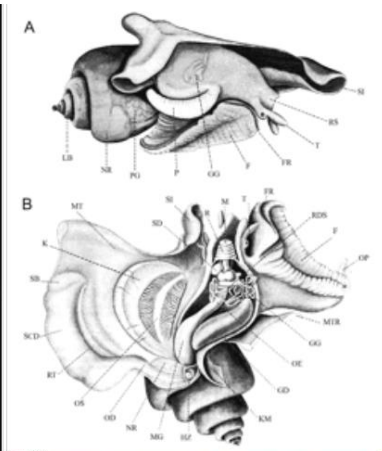
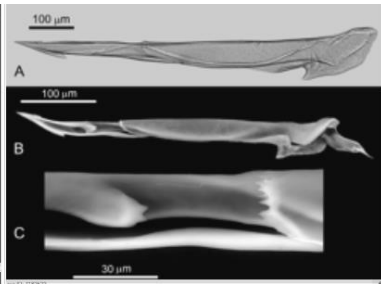
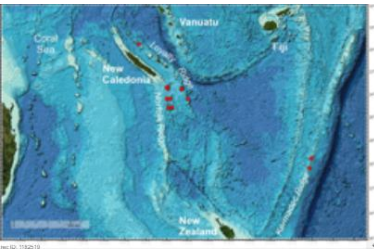
Phrynoponera pulchella Bolton & Fisher^{HNS} sp. n.

(Figures 5a-d) Holotype worker. TL 11.1, HL 2.48, HW 2.56, CI 103, SL 2.04, SI 80, PW 2.04, WL 3.76, maximum diameter of eye 0.56, OI 22.

FIGURE 5. *Phrynoponera pulchella*^{HNS} paratype worker CASENT0178204: A, dorsal view of body; B, dorsal view of petiole; C, lateral view of body; D, full-face view of head.

Mandible smooth with scattered setal pits, with 5 teeth, the basal tooth no more than a broad angle. Median portion of anterior clypeal margin with a small and extremely shallow median indentation which rounds broadly and evenly into the clypeal margin on each side; without a prominent tooth on each side of the midline. Dorsum of head near midline very finely and very densely rugulose, the narrow rugulae predominantly longitudinal but with some fine anastomoses; spaces between rugulae extremely finely reticulate-punctate to shagreenate. More laterally on cephalic dorsum, and behind the eyes, the reticulae are wider though no more strongly defined. Dorsum of mesosoma coarsely, irregularly reticulate-rugose, spaces between reticulae shagreenate. Metanotal groove in dorsal view visible laterally but



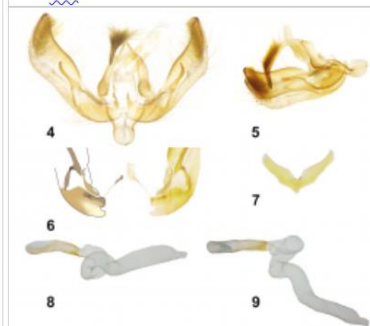
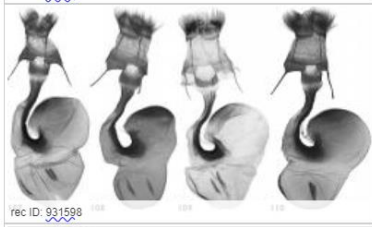
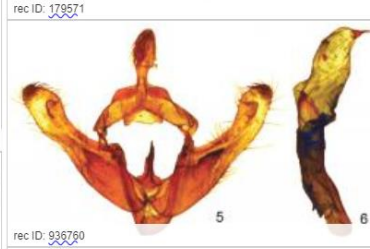
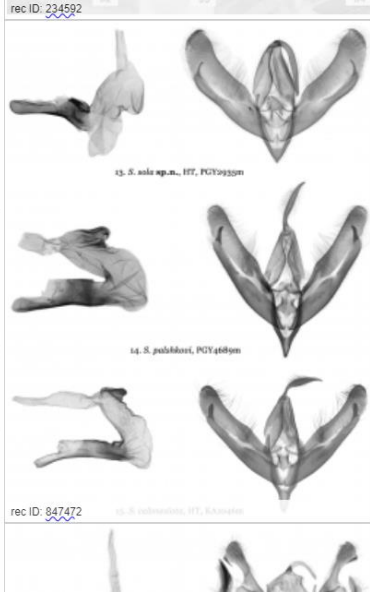
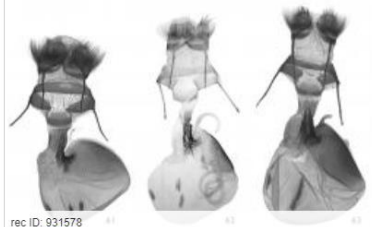
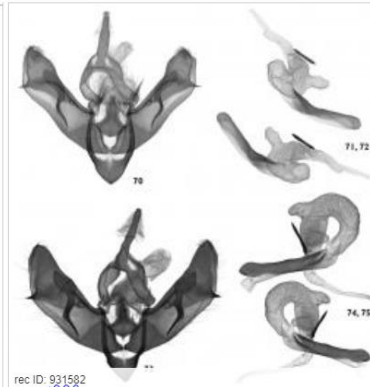
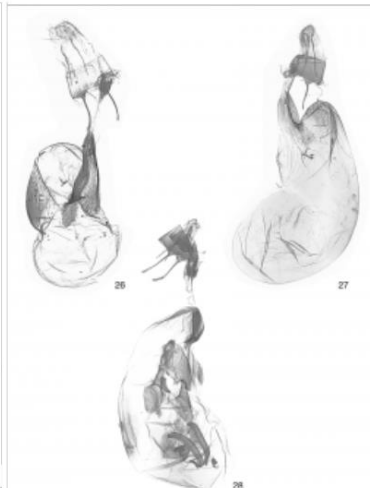
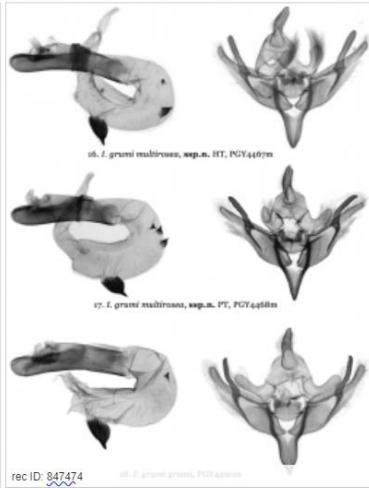
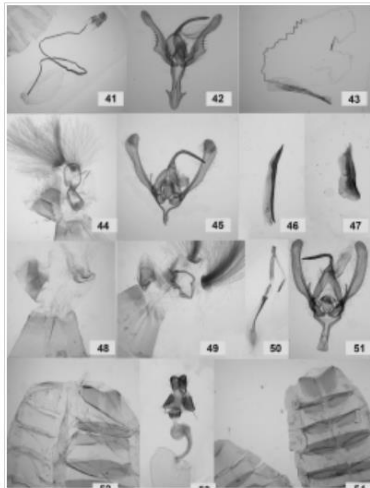
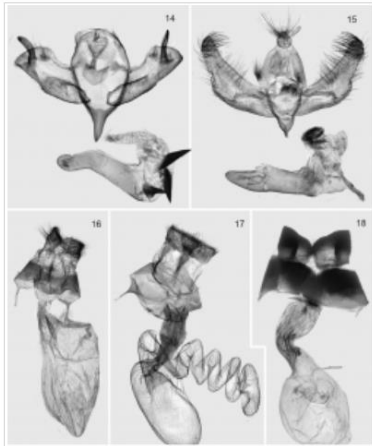


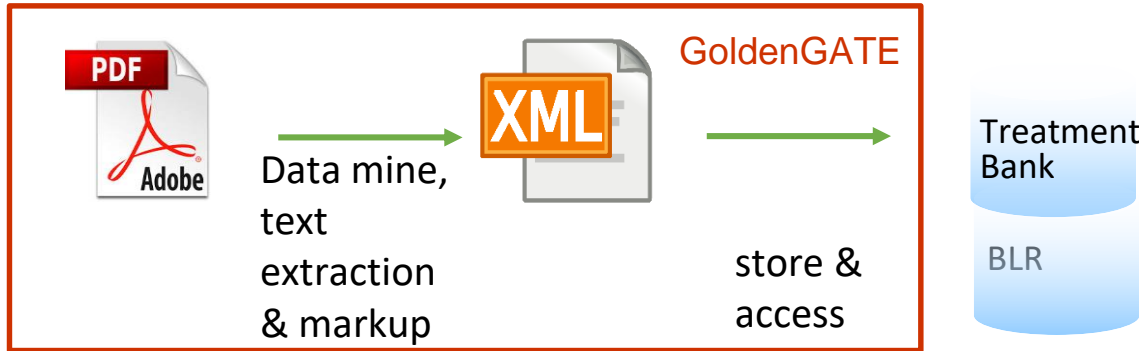


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noctuidae-genitalia

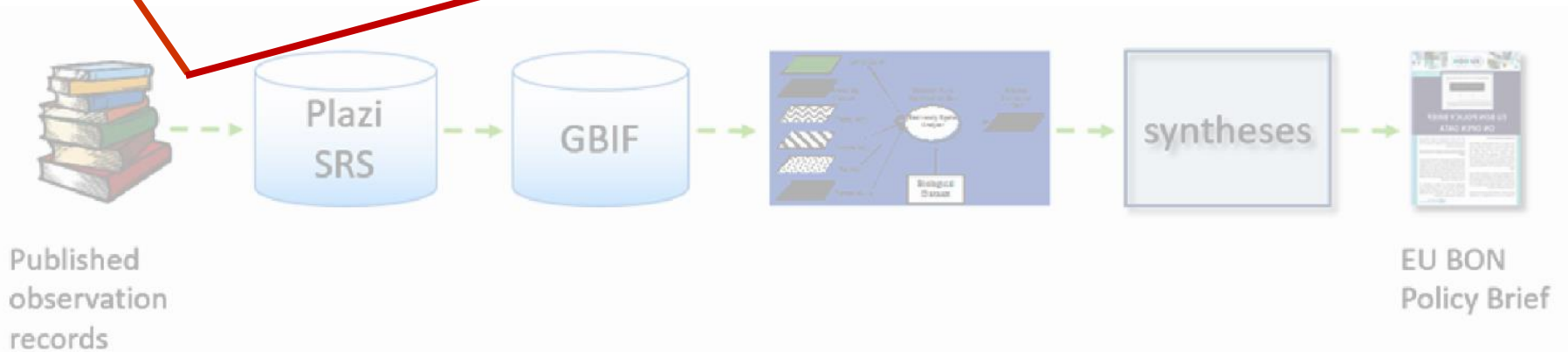
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Create the catalogue of life by machine



Expeditions to discover the known biodiversity

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Thank you!

Donat Agosti
agosti@plazi.org



Appendix: workflow

Plazi: conversion: keep the provenance



The screenshot displays a software interface for document metadata extraction. On the left, a file explorer shows a folder named 'annales_zoologici' containing 'ArchivosDeZoologia' and 'asianMyrmecology'. Below it, a document viewer shows a PDF page with text about the genus *Socratina*. The main window, titled 'Get Meta Data for Document candollea.c2014v691_65-73.pdf', contains a form for metadata extraction. The form includes fields for 'Publication Type' (set to 'Journal Article'), 'Authors', 'Title', 'Year', 'Journal', 'Part Designators' (with sub-fields for 'volume', 'issue', and 'numero'), 'Publisher', 'Location', and 'Editors'. Several of these fields are highlighted with red boxes. A 'Document View' window is overlaid on the bottom right, showing the document's title, authors, and abstract. The abstract text is: 'A synoptic revision of the Malagasy endemic genus *Socratina* Balle (Loranthaceae) Martin W. Callmander, Iacopo Luino, Simona Da-Giau, Charles Rakotovoao & Laurent Gautier. Abstract CALLMANDER, M. W., I. LUINO, S. DA-GIAU, C. RAKOTOVAO & L. GAUTIER (2014). A synoptic revision of the Malagasy endemic genus *Socratina* Balle (Loranthaceae). Candollea 69: 65-73. In English, English and French abstracts. The hemiparasitic endemic genus *Socratina* Balle (Loranthaceae) is revised for Madagascar. Three species are recognized, including a new one, *Socratina philippsonianae* Callm. & Luino. The vegetative and floral morphology of the new species is distinctive; in particular the conspicuous longitudinal villous fringe of long dendritic trichomes on the outer surface of its corolla along each suture of the lobes that contrasts with the shorter floccose indument that covers the rest of the outer corolla surface. All three known species are provided with preliminary risk assessments based on the IUCN Red List Categories and Criteria. A key to the genus is presented and a discussion of

Plazi: conversion: discovering images



The screenshot shows the GoldenGATE Imagine software interface. The main window displays a map of Madagascar with various geographical domains and distribution points. An 'Edit Attributes' dialog box is open over the map, showing the following details:

- caption: Fig. 1. - Map showing the ... domains sensu HUMBERT (1955).
- targetBox: [118,1493,279,1874]
- targetPageId: 2

The dialog box also includes fields for 'Attribute Name' and 'Attribute Value', and buttons for 'OK', 'Cancel', and 'Next'. The 'Display Control' sidebar on the right lists various elements that can be shown or hidden:

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- caption (checked)
- emphasis (checked)
- figureCitation (checked)
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At the bottom of the window, a caption reads: **Fig. 1.** Map showing the distribution of *Socrataina bemarvensis* (Lecomte) Balle (stars), *S. keraudreniana* Balle (squares) and *S. philippsoniana* Calim & Luino (circles) in Madagascar plotted on the map of phytogeographical domains sensu HUMBERT (1955).

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Page 2 / 9 (Nr. 66) Original Resolution Pages Top-Down

candollea.c2014v691_65-73.pdf

both *Taxillus* Tiegh. and *Vanwykia* Wiens, and with the latter, an eastern and south-eastern African genus, it shares styles with peculiar pluricellular ramified trichomes (POLHILL & WIENS, 1998). This character is absent in *Taxillus*, a predominantly south-east Asian genus of c. 35 species with a single species in East Africa, *T. wiensii* Pohl. (POLHILL & WIENS, 1999). *Vanwykia* was a recent molecular phylogenetic event to Madagascar. *Socratina* could be in East Africa (POLHILL & WIENS, 2008: 1026; see also POLHILL & WIENS, 2008: 1026).

Previous treatments of the genus *Socratina* described several species: *Socratina bemburana* Balle. They grow in the eastern dry bush and in the limestone region of Madagascar (Fig. 1). A recent review of material of the genus *Socratina* for the “Catalogue of the Vascular plants of Madagascar” (MADAGASCAR CATALOGUE, 2014) revealed a collection from the limestone region of Bemaraha (Jongkind & al. 3548) that did not match either of the currently known species. Subsequently, further collections of this undescribed species have been

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- block
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- region

Annotations

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- caption
- emphasis
- figureCitation
- heading
- pageNumber
- pageTitle

Edit Attributes

figureCitation Fig. 1

- captionStart: Fig. 1
- captionStartId: 2.[118,145,1905,1925]
- captionTargetBox: [118,1493,279,1874]
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- captionText: Fig. 1. –Map showing the distribution of *Socratina bemburana*

Attribute Name Add / Set Attribute

Attribute Value

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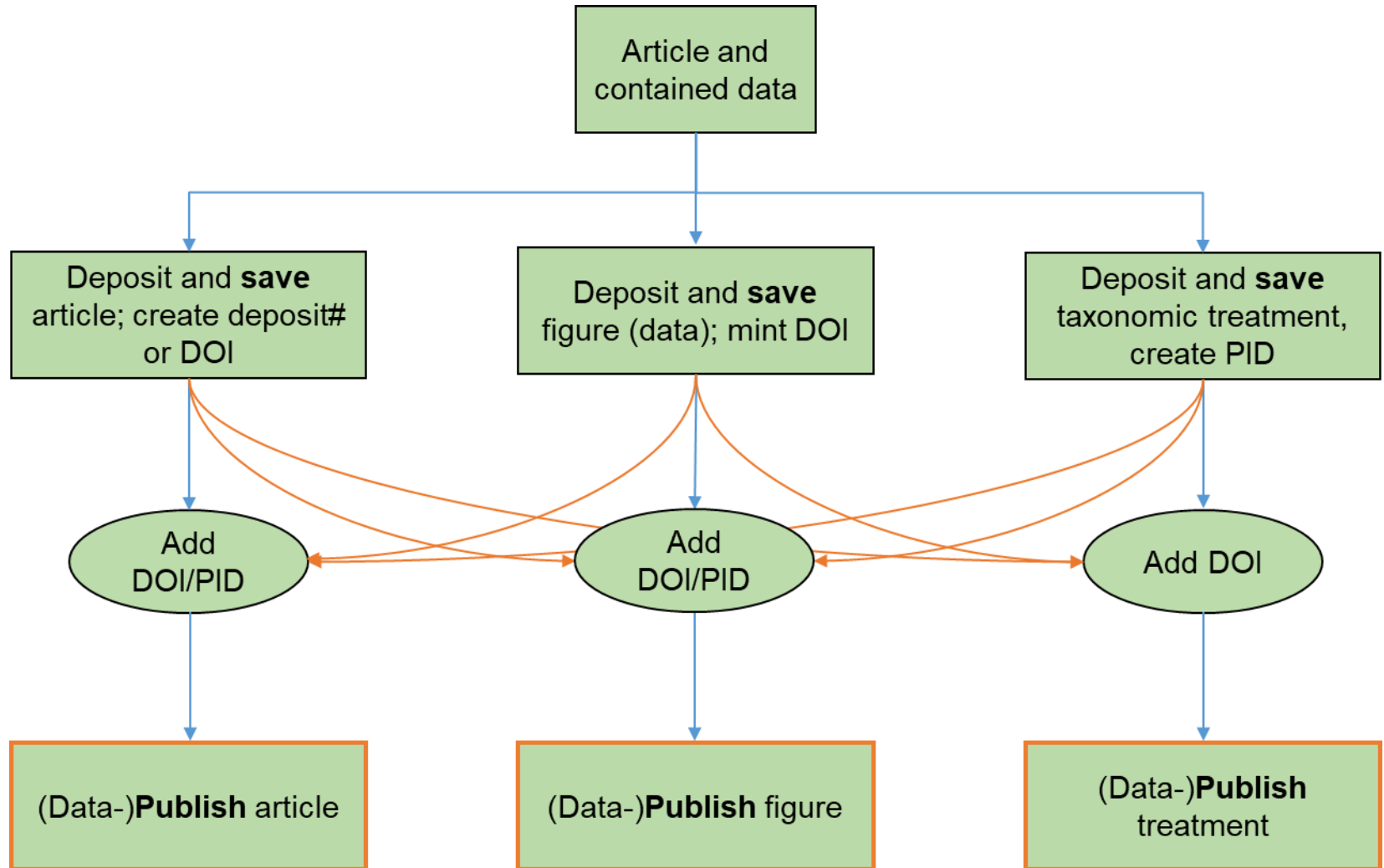
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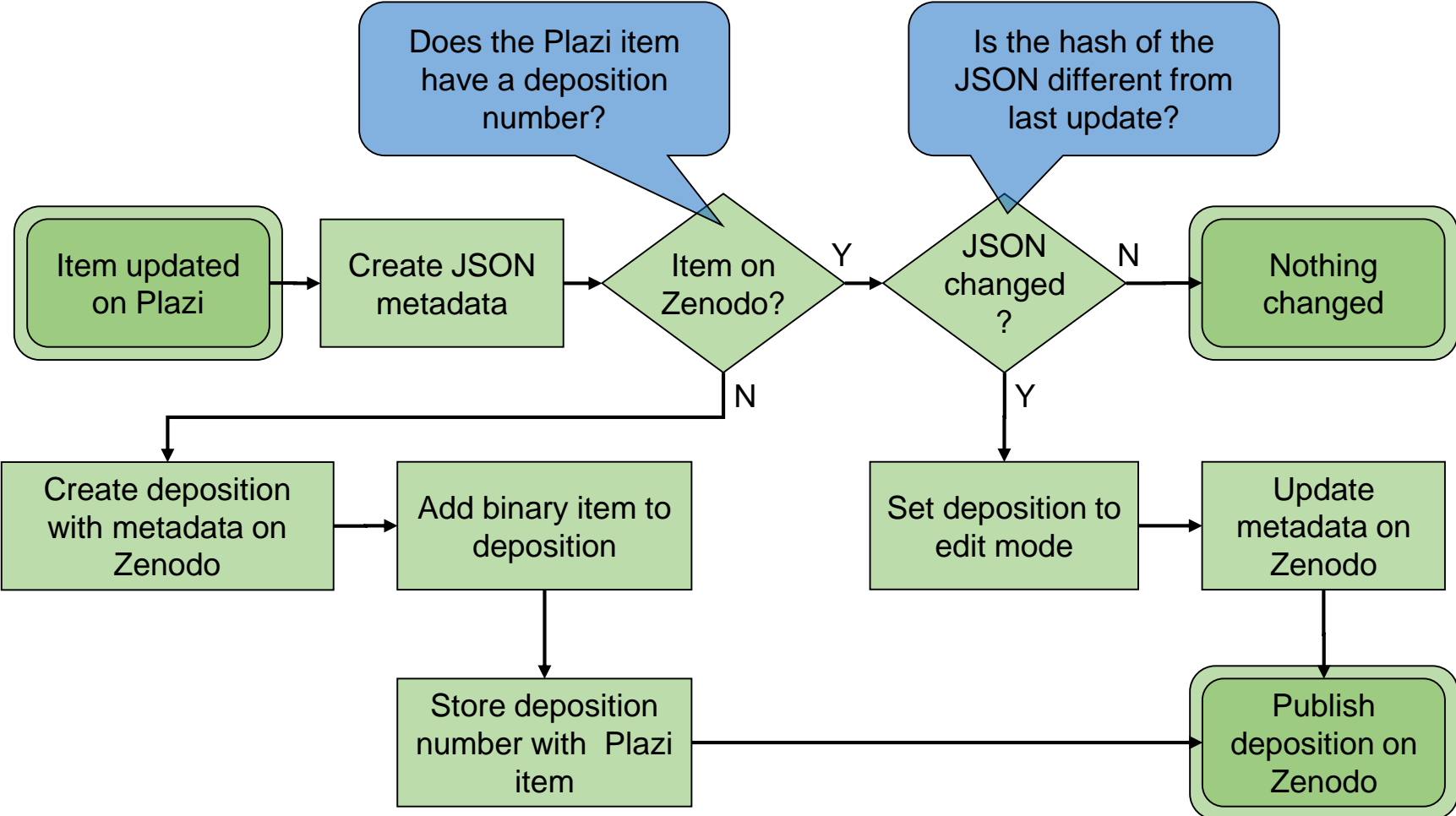
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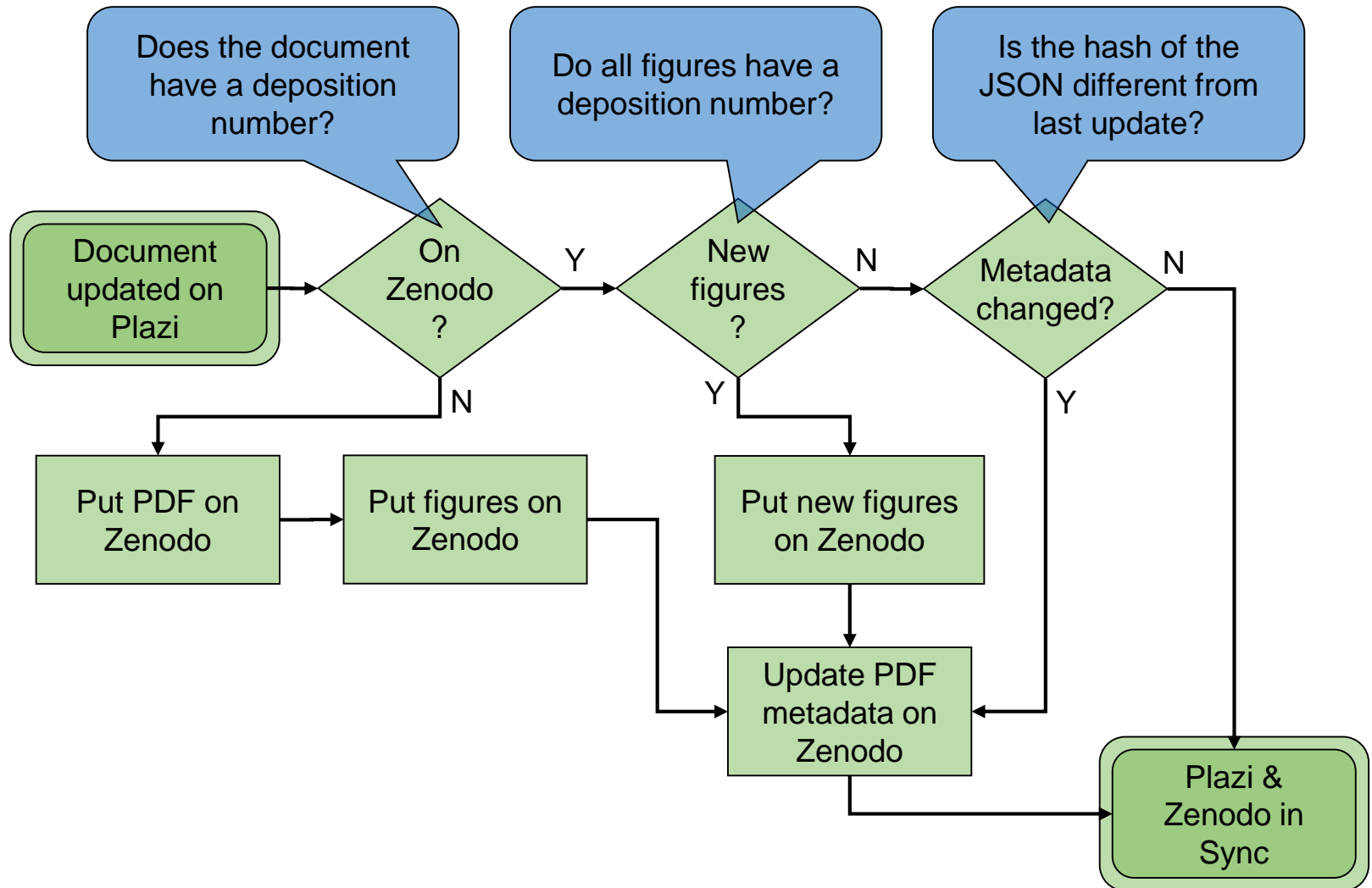
Fig. 1. - Map showing the distribution of *Socratra bamarivensis* Lecomete Balle (stars), *S. keraudreniana* Balle (squares) and *S. philippsoniana* Calm & Luind (circles) in Madagascar plotted on the map of phytogeographical domains sensu Humbert (1955).

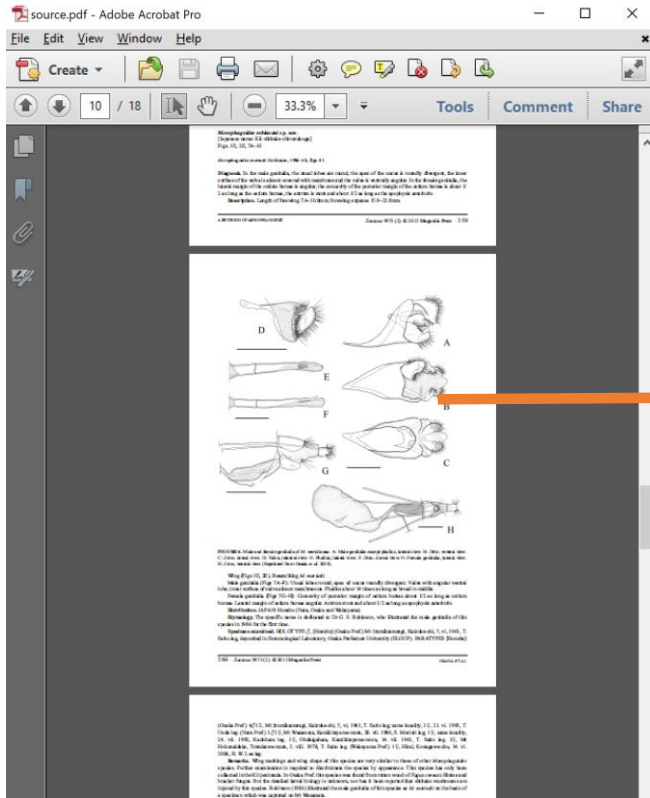
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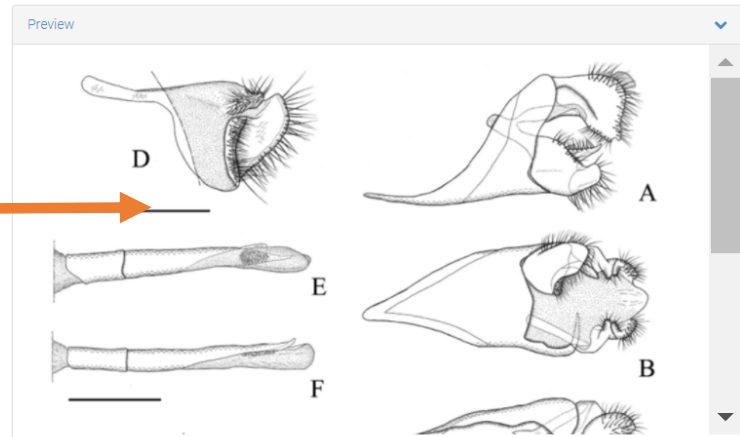
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FIGURE 6 in A revision of the genus *Morphogoides* Petersen (Lepidoptera, Tineidae) from Japan

Osada, Yohei; Sakai, Makoto; Hirowatari, Toshiya

FIGURE 6. Male and female genitalia of *M. meridianus*. A: Male genitalia except phallus, lateral view. B: Ditto, ventral view. C: Ditto, dorsal view. D: Valva, internal view. E: Phallus, lateral view. F: Ditto, dorsal view. G: Female genitalia, lateral view. H: Ditto, ventral view (Reprinted from Osada et al. 2014).



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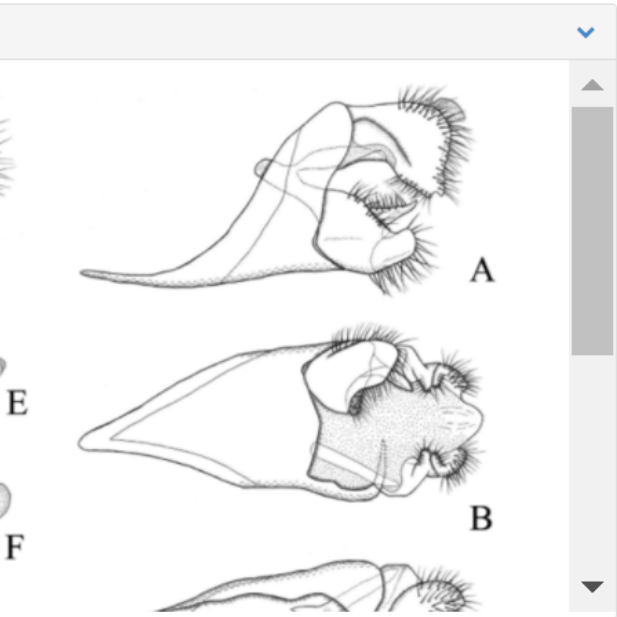
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enus. A: Male genitalia except phallus, lateral view. B: Ditto, ventral view. C:
s, lateral view. F: Ditto, dorsal view. G: Female genitalia, lateral view. H:
14).



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TABLE 2
K2P distances for mtDNA COI sequences of 11 species of *Pseudofulvodes*

Minimum Interspecific and Maximum Intraspecific Distances (%)

| | cer | pyr | xan | pol | kal | edw | sev | elo | ata | mes | zeu |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-----|
| <i>P. cerasinus</i> | 0.18 | | | | | | | | | | |
| <i>P. pyrius</i> | 3.50 | NA | | | | | | | | | |
| <i>P. xanthomus</i> | 11.34 | 11.23 | NA | | | | | | | | |
| <i>P. polackorum</i> | 9.47 | 9.47 | 7.50 | 0.31 | | | | | | | |
| <i>P. kaleidos</i> | 10.40 | 10.71 | 4.48 | 8.42 | NA | | | | | | |
| <i>P. edwardi</i> | 16.06 | 15.27 | 15.51 | 14.58 | 15.90 | 0.31 | | | | | |
| <i>P. severnsi</i> | 16.34 | 15.61 | 15.45 | 14.34 | 15.83 | 0.46 | 0.93 | | | | |
| <i>P. elongatus</i> | 18.80 | 20.38 | 19.16 | 18.69 | 19.60 | 15.81 | 16.14 | 0.62 | | | |
| <i>P. atavai</i> | 19.32 | 18.57 | 16.22 | 14.83 | 16.61 | 17.97 | 17.76 | 17.78 | 0 | | |
| <i>P. mesostigma</i> | 17.64 | 16.76 | 15.08 | 14.83 | 16.49 | 9.07 | 9.30 | 17.50 | 16.89 | 0.93 | |
| <i>P. zeus</i> , n. sp. | 17.49 | 17.23 | 16.28 | 17.09 | 17.51 | 9.29 | 8.61 | 17.94 | 18.20 | 5.31 | NA |

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(csv, text, excel)

| | cer | pyr | xan | pol | kal | edw | sev | elo | ata | mes | zeu |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-----|
| <i>P. cerasinus</i> | 0.18 | | | | | | | | | | |
| <i>P. pyrius</i> | 3.50 | NA | | | | | | | | | |
| <i>P. xanthomus</i> | 11.34 | 11.23 | NA | | | | | | | | |
| <i>P. polackorum</i> | 9.47 | 9.47 | 7.50 | 0.31 | | | | | | | |
| <i>P. kaleidos</i> | 10.40 | 10.71 | 4.48 | 8.42 | NA | | | | | | |
| <i>P. edwardi</i> | 16.06 | 15.27 | 15.51 | 14.58 | 15.90 | 0.31 | | | | | |
| <i>P. severnsi</i> | 16.34 | 15.61 | 15.45 | 14.34 | 15.83 | 0.46 | 0.93 | | | | |
| <i>P. elongatus</i> | 18.80 | 20.38 | 19.16 | 18.69 | 19.60 | 15.81 | 16.14 | 0.62 | | | |
| <i>P. atavai</i> | 19.32 | 18.57 | 16.22 | 14.83 | 16.61 | 17.97 | 17.76 | 17.78 | 0 | | |
| <i>P. mesostigma</i> | 17.64 | 16.76 | 15.08 | 14.83 | 16.49 | 9.07 | 9.30 | 17.50 | 16.89 | 0.93 | |
| <i>P. zeus</i> , n. sp. | 17.49 | 17.23 | 16.28 | 17.09 | 17.51 | 9.29 | 8.61 | 17.94 | 18.20 | 5.31 | NA |



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| year | part | pagination | DOI |
| publicationUrl | nextRef | volumeTitle | bookContentInfo |

BALLE, S. (1964a). Loranthees. In: HUMBERT, H. (ed.), Madagascar Comores 60.

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| <Not a citation> | ... Antananarivo 101, Madagascar. Submitted on February 24, 2014. Accepted on March 18, 2014. Introduction The ... |
| <Not a citation> | ... February 24, 2014. Accepted on March 18, 2014. Introduction The endemic Malagasy genus <i>Socratina</i> Balle (Loranthaceae ... |
| BALLE, S. (1964a): Loranthaceae | ... at anthesis (vs. short, straight) (BALLE, 1964 a). <i>Socratina</i> was placed in the subtribe <i>Tapinanthinae</i> Nickrent ... |
| NICKRENT, D. L. & MALECOT, R. VIDAL- RUSSELL (2010): A revised classification of Santalales | ... & Vidal-Russell along with 14 African and Arabian genera (NICKRENT & al., 2010). Among these genera, <i>Socratina</i> is unique in ... |
| BALLE, S. (1964b): Les Loranthaceae de Madagascar et des archipels voisins | ... appressed trichomes on the inner surface of the corolla-lobes (BALLE, 1964 b; POLHILL & WIENS, 1998). It nevertheless ... |
| POLHILL, R. (1998): D. WIENS | ... surface of the corolla-lobes (BALLE, 1964 b; POLHILL & WIENS, 1998). It nevertheless has strong morphological affinities with both ... |
| POLHILL, R. (1998): D. WIENS | ... , it shares styles with peculiar pluricellular ramified trichomes (POLHILL & WIENS, 1998). This character is absent in <i>Taxillus</i> , a ... |
| POLHILL, R. (1999): D. WIENS | ... in East Africa, T. wiensii Pohl. (POLHILL & WIENS, 1999). <i>Vanwykia</i> was revealed to be sister to <i>Socratina</i> ... |

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Introduction

The endemic Malagasy genus *Socratina* Balle (Loranthaceae) is distinguished from *Bakerella* Tiegh, the only other genus of Loranthaceae occurring in Madagascar, based on the presence of an indument at least on young parts (in *Bakerella*) and its long recurved filaments at a short, straight) (BALLE, 1964 a). *Socratina* was the subtribe *Tapinanthinae* Nickrent & Vidal-Russell along with 14 African and Arabian genera (NICKRENT & al., 2010). Among these genera, *Socratina* is unique in the an indument of straight appressed trichomes on the face of the corolla-lobes (BALLE, 1964 b; POLHILL & WIENS, 1998). It nevertheless has strong morphological affinities with both *Taxillus* (Tiegh) and *Vanwykia* Wiens, and with an eastern and south-eastern African genus: it shares styles with peculiar pluricellular ramified trichomes (POLHILL & WIENS, 1998). This character is absent in *Taxillus*, a mainly south-east Asian genus of c. 35 species with species in East Africa, *T. wiensii* Pohl. (POLHILL & WIENS, 1999). *Vanwykia* was revealed to be sister to *Socratina* in a recent molecular phylogenetic study and consequently a dispersal event to Madagascar from a common ancestor could be implied (VIDAL-RUSSELL & NICKRENT, 2010: 1026; see also BUERKI & al., 2013).

Previous treatments of *Socratina* recognised two well-defined species: *Socratina bemarkensis* (Lecomte) Balle and *S. keratodreniana* Balle. They are localized respectively in the south-western dry bush and in the dry deciduous forests of the northern part of Madagascar (Fig. 1). A recent review of material of the genus *Socratina* for the "Catalogue of the Vascular plants of Madagascar" (MADAGASCAR CATALOGUE 2014) revealed a collection from the limestone region of Bemaraha (Jongkind & al. 3548) that did not match either of the currently known species. Subsequently, further collections of this undescribed species have been made at sites on a similar substrate in the Beanka area, about 100 km to the north of Bemaraha. The Beanka forests have recently been the subject of intensive biodiversity inventories and a recently published monograph on the biodiversity of this inter-

based on the methods presented in CALLMANDER & al. (2007). A key to discriminate the three currently known species in the genus is presented and a discussion of the morphological affinities of each species is also provided.

Systematics

Socratina Balle in Adansonia ser. 2: 4: 135, 1964.
Typus: *Socratina bemarkensis* (Lecomte) Balle
Socratina bemarkensis (Lecomte) Balle in Adansonia ser. 2: 4: 135, 1964.
Loranthus bemarkensis Lecomte in Not. Syst. (Paris) 4: 37, 1923.
Tapinanthus bemarkensis (Lecomte) Danser in Verh. Kon. Akad. Wetensch. Afd. Natuurk., sect. 2: 29: 108, 1933.
Lectotypus (designed by BALLE, 1964 b): 135 MADAGASCAR, Prov. Maha-janga: Bois de la Haute Bemarivo, *S. philippsoniana*

Edit Attributes

bibRefCitation: BUERKI & al., 2013

author: BUERKI, S.
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 pagination: 304 - 329
 part: 171
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Introduction

The endemic Malagasy genus *Socratina* Balle (*Loranthaceae*) is distinguished from *Bakerella* Tiegh, the only other genus of *Loranthaceae* occurring in Madagascar, based on the presence of an indument at least on young parts (vs) glabrous in *Bakerella* and its long recurved filaments at anthesis (vs. short, straight) (BALLE, 1964a). *Socratina* was placed in the subtribe *Tapinanthinae* Nickrent & Vidal-Russell along with 14 African and Arabian genera (NICKRENT & al., 2010). Among these genera, *Socratina* is unique in the presence of an indument of straight appressed trichomes on the inner surface of the corolla lobes (BALLE, 1964b, 1998). It nevertheless has strong morphological similarities with both *Taxillus* (Tiegh) and *Vanwykia* (Wien) from an eastern and south-eastern African region with peculiar pluricellular ramified trichomes (WIENS, 1998). This character is absent in the only recently described, mainly south-east Asian genus of c. 35 species in East Africa, *T. wiensii* Pohl (2009). *Vanwykia* was revealed to be sister to *Socratina* in a recent molecular phylogenetic study and consequently a "dispersal event to Madagascar from a common ancestor with *Socratina* could be implied" (VIDAL-RUSSELL & NICKRENT, 2008: 1026; see also BUERRI & al., 2013).

Previous treatments of *Socratina* recognised two well-defined species, *Socratina bemarkensis* (Lecomte) Balle and *S. kerandreniana* Balle. They are localized respectively in the south-western dry bush and in the dry deciduous forests of the northern part of Madagascar (Fig. 1). A recent review of material of the genus *Socratina* for the "Catalogue of the Vascular plants of Madagascar" (MADAGASCAR CATALOGUE, 2014) revealed a collection from the limestone region of Bemaraha (Jongkind & al. 3548) that did not match either of the currently known species. Subsequently, further collections of this undescribed species have been made at sites on a similar substrate in the Beanka area about 100 km to the north of Bemaraha. The Beanka forests have recently been the subject of intensive biodiversity inventories and a recently published monograph on the biodiversity of this inte-

based on the methods presented in CALLMANDER & al. (2007). A key to discriminate the three currently known species in the genus is presented and a discussion of the morphological affinities of each species is also provided.

Key to the endemic Malagasy genus *Socratina*

1) Flowers buds c. 1-2 mm in diam. just prior to anthesis; corolla tube covered by a sparse indument, splitting distally between each of the five lobes at anthesis.....
S. kerandreniana

2) Flowers buds c. 1-2 mm in diam. just prior to anthesis; corolla tube covered by a sparse indument, splitting mostly between each of the five lobes at anthesis.....
S. bemarkensis

3) Flowers buds c. 1-2 mm in diam. just prior to anthesis; corolla tube covered by a sparse indument, splitting mostly between each of the five lobes at anthesis; corolla with two long trichomes on the inner surface of each lobe, relatively sparse indument over the entire surface and with conspicuous villous fringe of long trichomes on the outer surface of its corolla longitudinal along each suture.....
S. phillipsoniana

Systematics

Socratina Balle in Adansonia ser. 2, 4: 135, 1964.
Typus: *Socratina bemarkensis* (Lecomte) Balle
Socratina bemarkensis (Lecomte) Balle in Adansonia ser. 2, 4: 135, 1964.
 = *Loranthus bemarkensis* Lecomte in Not. Syst. (Paris) 4: 37, 1923.
 = *Tapinanthus bemarkensis* (Lecomte) Danser in Verh. Kon. Akad. Wetensch. Afd. Natuurk., sect. 2, 29: 108, 1933.
Lectotypus (designed by BALLE, 1964b: 135): MADAGASCAR, Prov. Maha-janga: Bois de la Haute Bemariva.

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Introduction

The endemic Malagasy genus *Socratina* Balle (Loranthaceae) is distinguished from *Bakerella* Tiegh, the only genus of *Loranthaceae* occurring in Madagascar based on presence of an indument at least on young parts (vs. glabrous in *Bakerella*) and its long recurved filaments at anthesis (short, straight) (BALLE, 1964a). *Socratina* was placed in the subtribe *Tapinanthinae* Nickrent & Vidal-Russell with 14 African and Arabian genera (NICKRENT & al., 2008). Among these genera, *Socratina* is unique in the presence of an indument of straight appressed trichomes on the inner face of the corolla lobes (BALLE, 1964b; POLHILL & WIEENS, 1998). It nevertheless has strong morphological affinity with both *Taxillus* Tiegh and *Vanwykia* Wiens, and with the eastern and south-eastern African genus, it shares with peculiar pluricellular ramified trichomes (POLHILL & WIEENS, 1998). This character is absent in *Taxillus*, a primarily south-east Asian genus of c. 35 species with a species in East Africa, *T. wiensii* Pohl (POLHILL & WIEENS, 1999). *Vanwykia* was revealed to be sister to *Socratina* in a recent molecular phylogenetic study and consequently a dispersal event to Madagascar from a common ancestor of *Socratina* could be implied (VIDALL-RUSSELL & NICKRENT, 2008; 1026; see also BUERKI & al., 2013).

Previous treatments of *Socratina* recognised two well-defined species: *Socratina bemarivensis* (Lecomte) Balle and *S. kerandreniana* Balle. They are localized respectively in the south-western dry bush and in the dry deciduous forests of the northern part of Madagascar (Fig. 1). A recent review of material of the genus *Socratina* for the "Catalogue of the Vascular plants of Madagascar" (MADAGASCAR CATALOGUE, 2014) revealed a collection from the limestone region of Bemaraha (Jongkind & al., 3548) that did not match either of the currently known species. Subsequently, further collections of this undescribed species have been made at sites on a similar substrate in the Beanka area, about 100 km to the north of Bemaraha. The Beanka forests have recently been the subject of intensive biodiversity inventories and a recently published monograph on the biodiversity of this interesting area (GOODMAN & al., 2013), including a check list of vas-

based on the methods presented in CALLMANDER & al. (2007).

Edit Attributes

taxonomicName: *Socratina bemarivensis* (Lecomte) Balle

_evidence: catalogs

_step: species 1

authority: (Lecomte) Balle

authorityName: (Lecomte) Balle

class: Magnoliopsida

family: Loranthaceae

genus: *Socratina*

kingdom: Plantae

order: Santalales

phylum: Tracheophyta

rank: species

species: bemarivensis

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Systematics

Socratina Balle in *Adansonia* ser. 2, 4: 135, 1964.

Typus: *Socratina bemarivensis* (Lecomte) Balle

Socratina bemarivensis (Lecomte) Balle in *Adansonia* ser. 2, 4: 135, 1964.

Loranthus bemarivensis Lecomte in *Not. Syst.* (Paris) 4: 37, 1923.

Tapinanthus bemarivensis (Lecomte) Danser in *Verh. Kon.-Akad. Wetensch. Afd. Naturk.* sect. 2, 29: 108, 1933.

Lectotypus (designed by BALLE, 1964b: 135): MADAGASCAR, Prov. Mahajanga: Bois de la Haute Bemariva, [16°06'S 47°44'E], XI 1918, II, *Perrier de la Bâtie* 10646.

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volumeTitle
year



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| | |
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| Start 'multiple' SubSection | ▼ Martin W. Callmander, Jacopo Luino, Smona Da-Giau, Charles Rakotoivoa & Laurent Gautier (page 65) |
| Start 'abstract' SubSection | ▼ Abstract (page 65) |
| Continue SubSection | ▼ CALLMANDER, M. W., I. LUINO, S. DA-GIAU, C. RAKOTOIVOAO & (page 65) |
| Continue SubSection | ▼ L. GAUTIER (2014). A synoptic revision of the Malagasy endemic genus <i>Socratina</i> Balle (Loranthaceae). <i>Candollea</i> 69: 65 - 73. In English, English and French abstracts. (page 65) |
| Continue SubSection | ▼ The hemiparasitic endemic genus <i>Socratina</i> Balle (Loranthaceae) is revised for Madagascar. Three species are recognized, including a new one, <i>Socratina</i> [...] Categories and Criteria. A key to the genus is presented and a discussion of the morphological affinities of each species is also provided. (page 65) |
| Continue SubSection | ▼ Resume (page 65) |
| Continue SubSection | ▼ CALLMANDER, M. W., I. LUINO, S. DA-GIAU, C. RAKOTOIVOAO & (page 65) |
| Continue SubSection | ▼ L. GAUTIER (2014). Une révision synoptique du genre endémique malgache <i>Socratina</i> Balle (Loranthaceae). <i>Candollea</i> 69: 65 - 73. En anglais, résumés anglais et français. (page 65) |
| Continue SubSection | ▼ Le genre hemiparasite endémique <i>Socratina</i> Balle (Loranthaceae) est révisé pour Madagascar. Trois espèces sont reconnues, y compris une nouvelle, <i>Socratina</i> [...] la Liste Rouge de LUIJON. Une clé de genre est présentée et une discussion des affinités morphologiques de chaque espèce est également fournie. (page 65) |
| Continue SubSection | ▼ Key-words (page 65) |
| Start 'treatment' SubSection | ▼ ORANTHACEAE - <i>Socratina</i> - Bearia - Madagascar - Taxonomy - Conservation (page 65) |
| Continue SubSection | ▼ Addresses of the authors: MWC: Missouri Botanical Garden, P. O. Box 299, St. Louis, MO, 63166 - 0299, U. S. A. and Conservatoire et Jardin botaniques de la Ville de Genève, ch. de l'Impératrice 1, CP 60, 1292 Chambésy, Switzerland. Email: martin.callmander@mobot.org (page 65) |
| Continue SubSection | ▼ LI, SDG, LG: Conservatoire et Jardin botaniques de la Ville de Genève and Université de Genève, Laboratoire universitaire Systématique végétale et biodiversité, CP 60, 1292 Chambésy, Switzerland. (page 65) |
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| Continue SubSection | ▼ Submitted on February 24, 2014. Accepted on March 18, 2014. (page 65) |
| Start 'introduction' SubSection | ▼ Introduction (page 66) |
| Continue SubSection | ▼ The endemic Malagasy genus <i>Socratina</i> Balle (Loranthaceae) is distinguished from <i>Bakerella</i> Tiegh., the only other genus of Loranthaceae occurring in Madagascar [...] <i>Socratina</i> could be implied " (VIDALL- RUSSEL & NICKRENT, 2008: 1026; see also BUEKLI & al., 2013). (page 66) |
| Continue SubSection | ▼ Previous treatments of <i>Socratina</i> recognised two well-defined species: <i>Socratina</i> <i>beharivensis</i> (Lecomte) Balle and <i>S. keraudreniana</i> Balle. They are localized respectively [...] and plants (LETSARA & al., 2012; CALLMANDER & al., 2013; GAUTIER & DEROIN, 2013). (page 66) |
| Continue SubSection | ▼ In the present article, we provide a synoptic revision of <i>Socratina</i> and describe a new species endemic to western Madagascar, <i>S. philippiniana</i> [...] discriminate the three currently known species in the genus is presented and a discussion of the morphological affinities of each species is also provided. (page 66) |
| Start 'treatment' SubSection | ▼ Key to the endemic Malagasy genus <i>Socratina</i> (page 66) |
| Continue SubSection | ▼ 1. Flowers buds c. 1 - 2 mm in diam. just prior to anthesis; corolla tube covered by a sparse indument; splitting distally between each of the five lobes at anthesis <i>S. keraudreniana</i> (page 66) |
| Continue SubSection | ▼ 1a. Flowers buds c. 4 - 6 mm in diam. just prior to anthesis; corolla tube covered by a dense indument, splitting mostly unilaterally at anthesis 2 (page 66) |
| Continue SubSection | ▼ 2. Mature leaves and petiole covered by a russet indument; corolla with a dense uniform external indument <i>S. beharivensis</i> (page 66) |
| Continue SubSection | ▼ 2a. Mature leaves and petiole glabrescent; corolla with two different external indument types: a uniform, relatively sparse indument over the entire surface, and with conspicuous villous fringe of long trichomes on the outer surface of its corolla longitudinal along each suture <i>S. philippiniana</i> (page 66) |
| Continue SubSection | ▼ Systematics (page 66) |
| Start 'treatment' SubSection | ▼ <i>Socratina</i> Balle in Adansonia ser. 2, 4: 135. 1964. (page 66) |
| Continue SubSection | ▼ Typus: <i>Socratina</i> <i>beharivensis</i> (Lecomte) Balle (page 66) |
| Start 'treatment' SubSection | ▼ <i>Socratina</i> <i>beharivensis</i> (Lecomte) Balle in Adansonia ser. 2, 4: 135. 1964. (page 66) |
| Continue SubSection | ▼ ≠ <i>Loranthus</i> <i>beharivensis</i> Lecomte in Not. Syst. (page 66) |
| Continue SubSection | ▼ (Paris) 4: 37. 1923. (page 66) |
| Continue SubSection | ▼ ≠ <i>Tapinanthus</i> <i>beharivensis</i> (Lecomte) Danser in Verh. (page 66) |
| Continue SubSection | ▼ Kon. Akad. Wetensch., Afd. Naturk., sect. 2. 29: (page 66) |
| Continue SubSection | ▼ 108. 1933. (page 66) |
| Continue SubSection | ▼ Lectotypus (designated by BALLE, 1964 b: 135): MADA- (page 66) |
| Continue SubSection | ▼ GASCAR. Prov. Mahajanga: Bois de la Haute Beharivo, (page 66) |
| Continue SubSection | ▼ [16° 06' S 47° 44' E], XI. 1918, fl., Perrier de la Bathie 10646 (page 66) |
| Continue SubSection | ▼ [P: [P 00573453]]; isolecto- P [P 0573454, P 0573455]]. (page 66) |
| Continue SubSection | ▼ Conservation status. - With an EOO of 2,336 km ² and an AOO of 27 km ² and three subpopulations, none situated within the protected area network, <i>S. beharivensis</i> is assigned a preliminary status of "Vulnerable" [VU B 1 ab (i) + 2 ab (i)] following IUCN Red List Categories and Criteria (IUCN, 2012). (page 66) |
| Continue SubSection | ▼ Notes. - <i>Socratina</i> <i>beharivensis</i> was originally described in <i>Loranthus</i> Jacq. by LECOMTE (1923) following the very broad generic concept of ENGLER [...] vs. corolla slender covered by short (1 - 1.5 mm) trichomes forming a sparse indument) (Fig. 2). (page 66) |

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 Please select to which **data domain** (e.g. *nomenclature* or *description*) of the treatment these paragraphs belong.

| | |
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| nomenclature | ▼ <i>Socratina bemarivensis</i> (Lecomte) Balle in <i>Adansonia</i> ser. 2, 4: 135. 1964. |
| reference_group | ▼ ≠ <i>Loranthus bemarivensis</i> Lecomte in <i>Not. Syst. (Paris)</i> 4: 37. 1923. |
| reference_group | ▼ ≠ <i>Tapinanthus bemarivensis</i> (Lecomte) Danser in <i>Verh. Kon. Akad. Wetensch., Afd.Natuurk., sect. 2</i> : 29: 108. 1933. |
| materials_examined | ▼ Lectotypus (designed by BALLE, 1964b: 135): MADA- GASCAR. Prov. Mahajanga: Bois de la Haute Bemarivo, [16°06'S 47°44'E], XI.1918, fl., Perrier de la Bathie 10646 (P [P00573453]!; isolecto-: P [P0573454, P0573455]!). |
| biology_ecology | ▼ Conservation status. - With an EOO of 2,336 km ² , and an AOO of 27 km ² and three subpopulations, none situated within the protected area network, <i>S. bemarivensis</i> is assigned a preliminary status of "Vulnerable" [VU B1ab(i)+2ab(i)] following IUCN Red List Categories and Criteria (IUCN, 2012). |
| discussion | ▼ Notes. - <i>Socratina bemarivensis</i> was originally described in <i>Loranthus</i> Jacq. by LECOMTE (1923) following the very broad generic concept of ENGLER & KRAUSE (1935), a genus that is now circumscribed as mostly restricted to temperate or mountain forest from Europe to south-east Asia (BARLOW, 1997). Henri Perrier de la Bathie, who collected both syntypes wrote on the label of one of them (Perrier de la Bathie 10652), that the flowers open at maturity with only one longitudinal split along the entire length of the corolla lobes (see BALLE, 1964b: 137). Anthesis of <i>S. bemarivensis</i> is very different to that of <i>Socratina keraudreniana</i> where the corolla divides into five lobes in the distal part (Fig. 2). Several other characters of the morphology of its leaves and flowers allow to differentiate those two species: limb sub-orbicular to largely ovate, 0.8-4.8 cm in width in <i>S. bemarivensis</i> (vs. oblanceolate to obovate, 0.3-0.8 cm in <i>S. keraudreniana</i>); corolla broad, covered with long (2-2.5 mm) trichomes forming dense indument (vs. corolla slender covered by short (1-1.5 mm) trichomes forming a sparse indument) (Fig. 2). |
| discussion | ▼ Perrier de la Bathie noted several hosts for <i>Socratina bemarivensis</i> : <i>Acacia</i> sp. and <i>Dalbergia</i> sp. (Leguminosae), <i>Eugenia</i> sp. (Myrtaceae) and <i>Vernonia</i> sp. (Asteraceae) (BALLE, 1964b). Most Loranthaceae species seem to have a wide range of hosts (POLHILL & WIENS, 1998) but some species have also very restricted hosts such as <i>Taxillus wiensii</i> known only to grow on <i>Cynometra webberi</i> Baker f. (Leguminosae) (POLHILL & WIENS, 1998). Further studies are needed in Madagascar to determine if the genus <i>Socratina</i> has host specificity as this information is recorded on very few collections (see also comments under <i>S. keraudreniana</i>). |
| materials_examined | ▼ Additional material examined. - MADAGASCAR.Prov.Antsirananana: Ambilobe, Ambakirano, Behefaka, Anjahana, foret d'Ampivanana, 9 km au S de Behefaka, 13°21'12"S 49°09'11"E, 276 m, 6.V.2005, fl. & fr., Ratovoson 105 (CNARP, MO, P [P06714072], TAN). Prov. Mahajanga: Bord de l'Anovilava, affluent du Bemarivo (Boina), [16°09'S 47°51'E], VI.1906, fl., Perrier de la Bathie 10642 (P [P05447659, P05447668, P05447669] [syntypes]!). |

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Lectotypus (designed by BALLE, 1964b: 135): MADA- GASCAR, Prov. Mahajanga: Bois de la Haute Bemarivo, [16°06'S 47°44'E], XI.1918, fl., Perrier de la Bâthie 10646 (P [P00573453]);

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materialsCitation Lectotypus (designed by ... 10646 (P [P 00573453]);

- collectingDate: 1918-11
- collectionCode: P
- collectorName: Perrier de la Bâthie
- country: MADA- GASCAR
- latitude: -16.1
- location: Bois de la Haute Bemarivo
- longLatPrecision: 1283
- longitude: 47.733334
- municipality: Prov. Mahajanga
- specimenCode: 10646, P00573453
- specimenCount: 1
- typeStatus: lectotype

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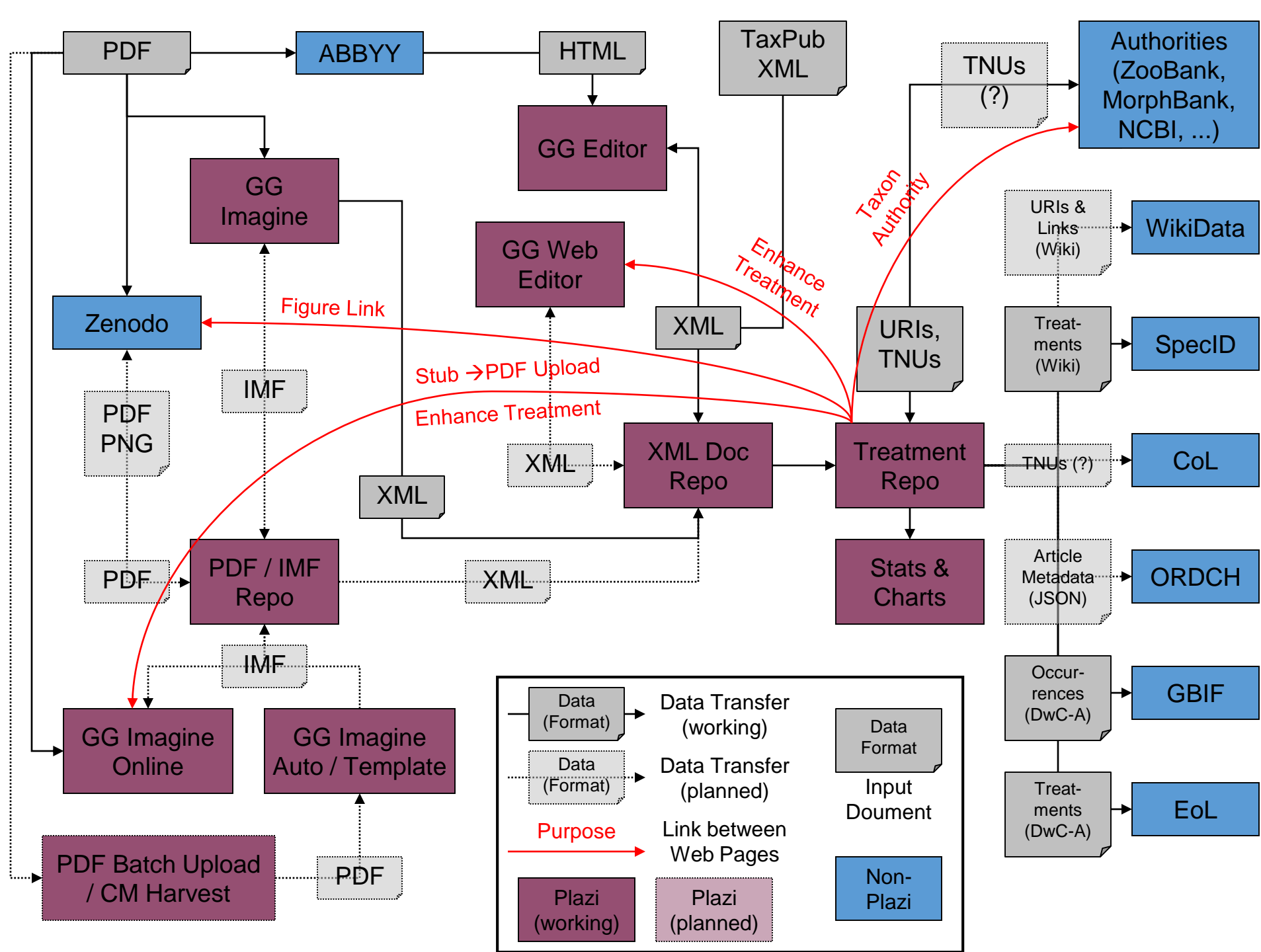
Loranthus bemarivensis Lecomte in Not. Syst.
(Paris) 4: 37. 1923.

Tapinanthus bemarivensis (Lecomte)
Kon. Akad. Wetensch., Afd. Naturk.
108. 1933.

Lectotypus (designed by BALLE, 1964b: 135):
MADA- GASCAR, Prov. Mahajanga: Bois de la Haute Bemarivo,
[16°06'S 47°44'E], XI.1918, fl., Perrier de la Bâthie 10646 (P [P 00573453]); isolecto-: P [P 00573453];

Conservation status. - With an EOO of 27 km² and three subpopulations, the protected area network, *S. bemarivensis* has a preliminary status of "Vulnerable" [VU Blab(i)+2ab(i)] following IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. - *Socratina bemarivensis* was originally described in *Loranthus* Jacq. by LECOMTE (1923) following the very broad generic concept of ENGLER & KRAUSE (1935), a genus that is now circumscribed as mostly restricted to temperate or mountain forest from Europe to south-est Asia (BARLOW, 1997). Henri Perrier de la Bâthie, who collected both syntypes





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(Agosti&Egloff, 2009).