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world of biodiversity

# Primary data and Entomological collections: utility, best practices and challenges.

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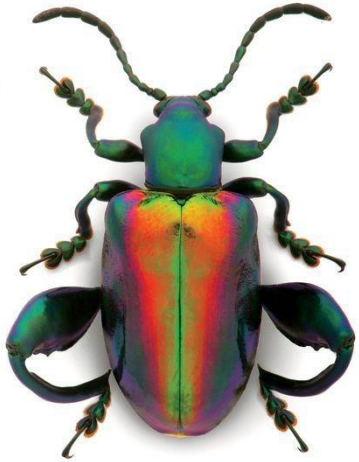
msimoes123

Member of the Leibniz Association
FAIR Heritage
Digital Methods, Scholarly Editing and Tools for Cultural and Natural Heritage
Intelligence Patrimoines
LE STUDIUM Loire Valley Institute for Advanced Studies
MASA



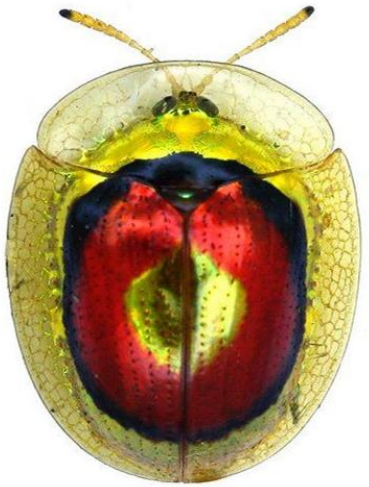




# Beetles



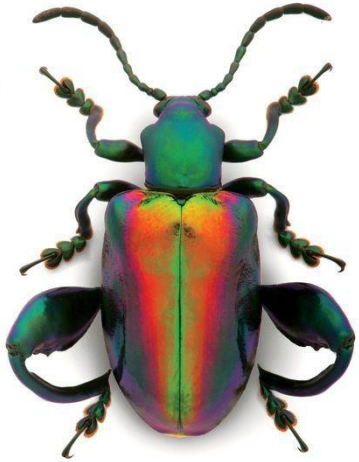




Source: https://www.pinterest.com/pin/161777811592282012/

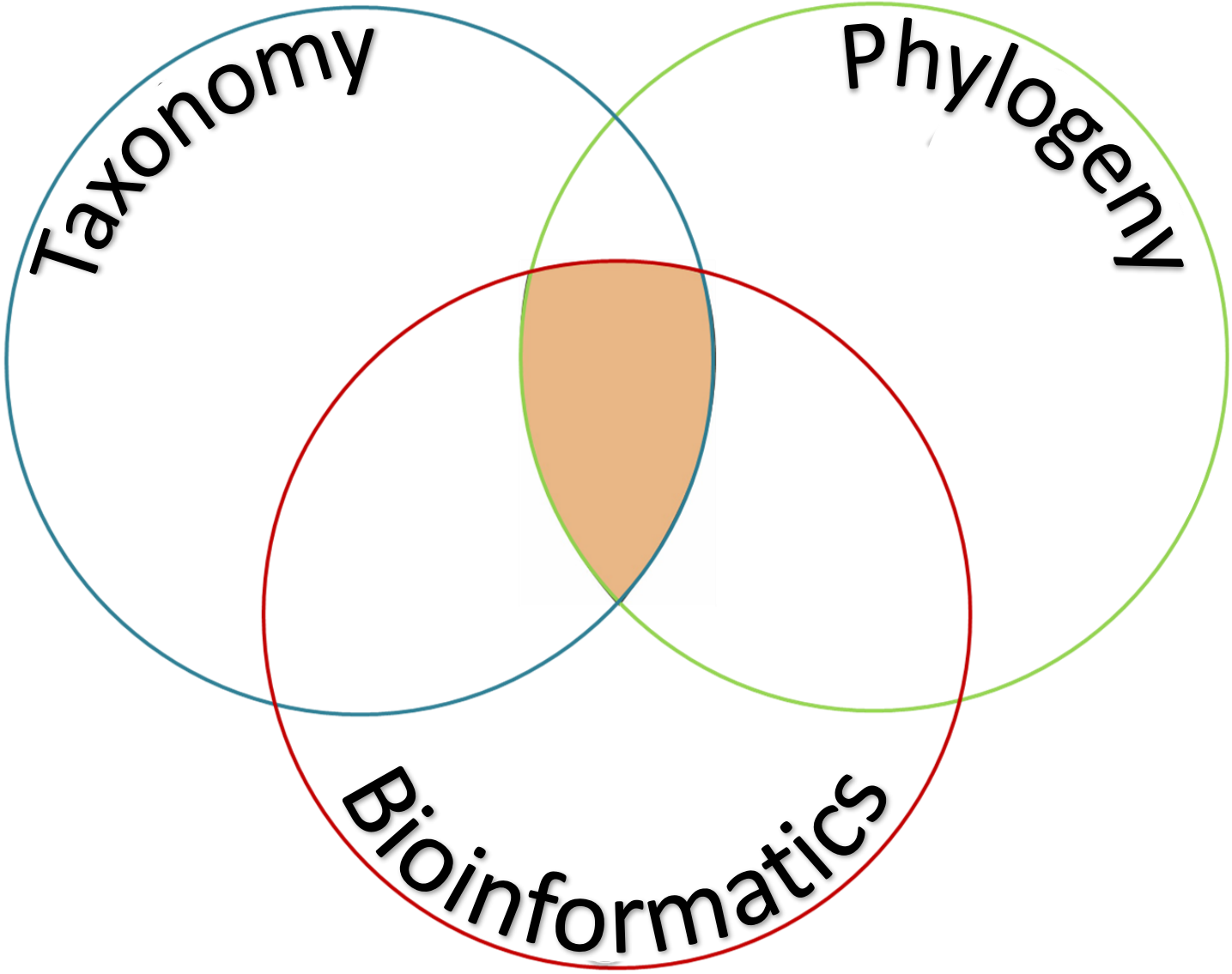




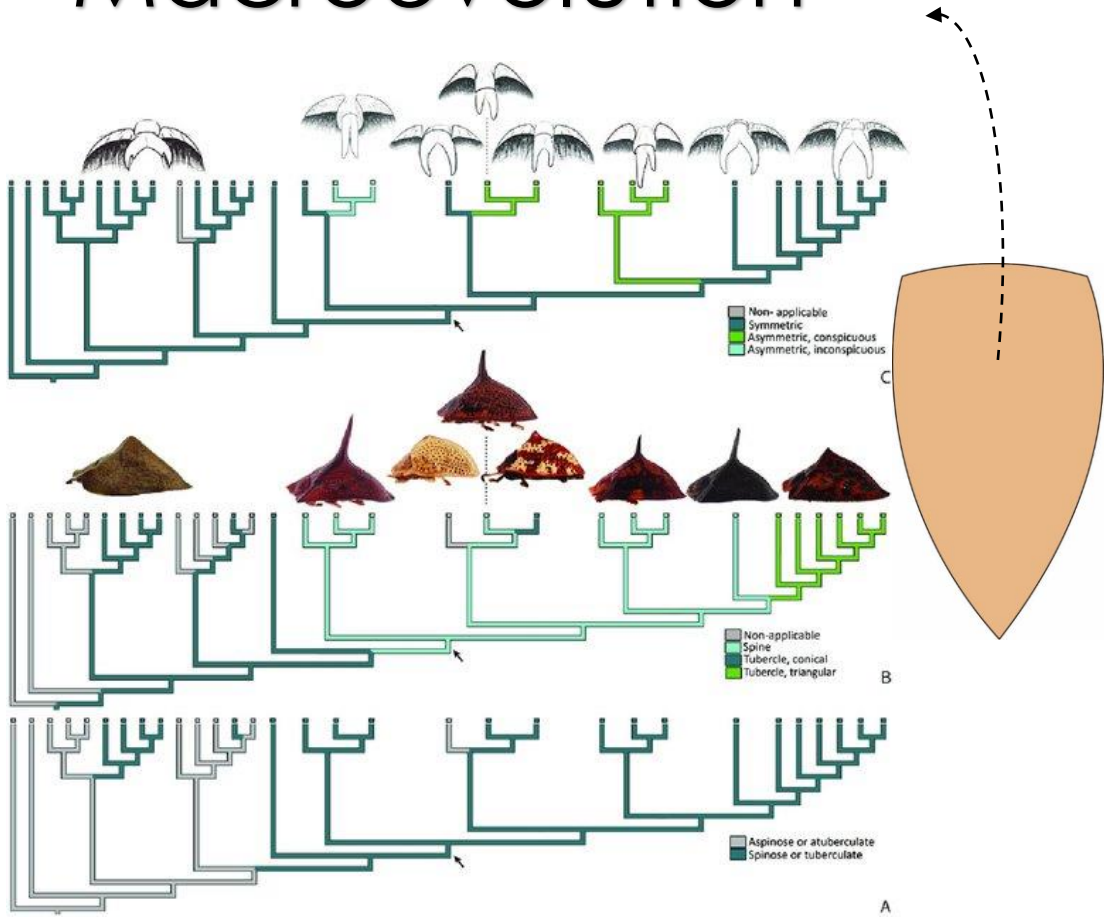


# Leaf-beetles



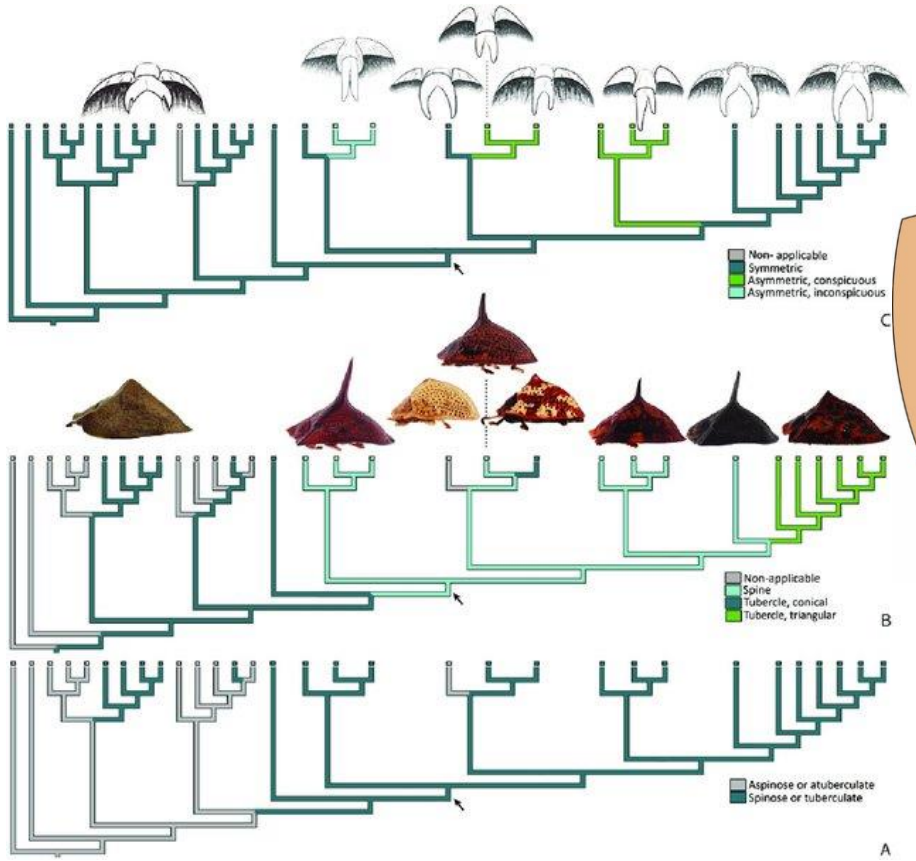

Taxonomy
Phylogeny
Bioinformatics

# Macroevolution

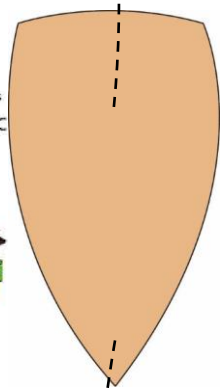


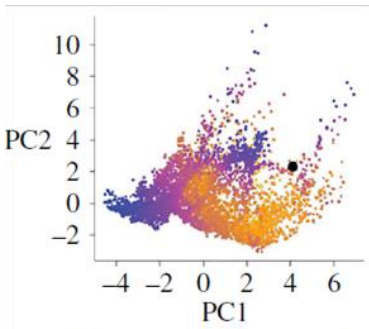

Simões et al, 2018

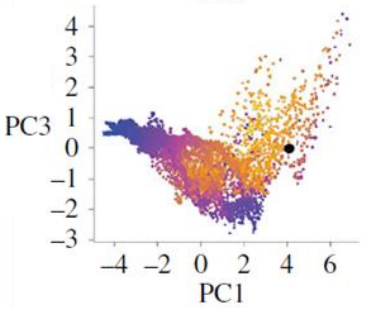
# Macroevolution

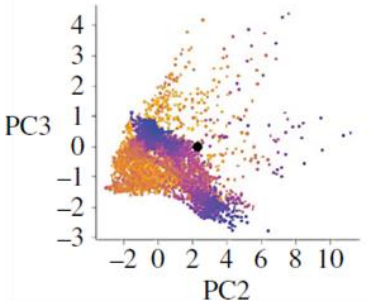



Simões et al, 2018






0°

40°

Simões et al., 2016

# Macroecology

# Collection-based Research

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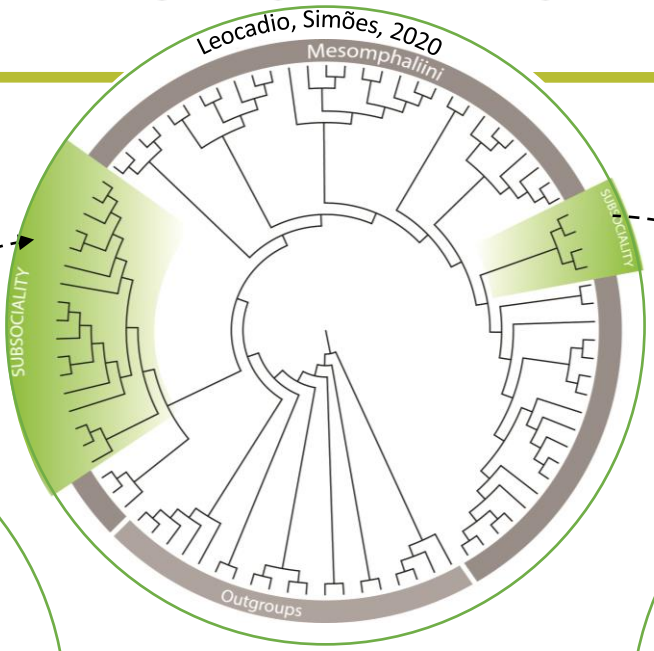
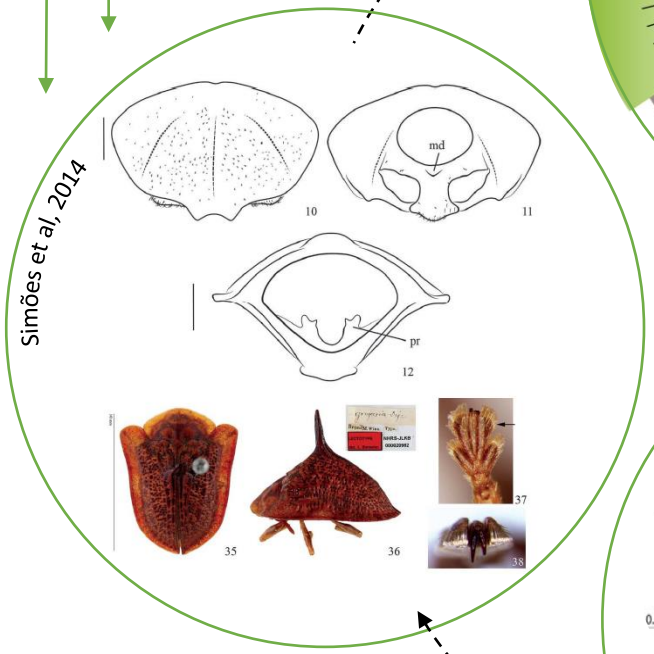
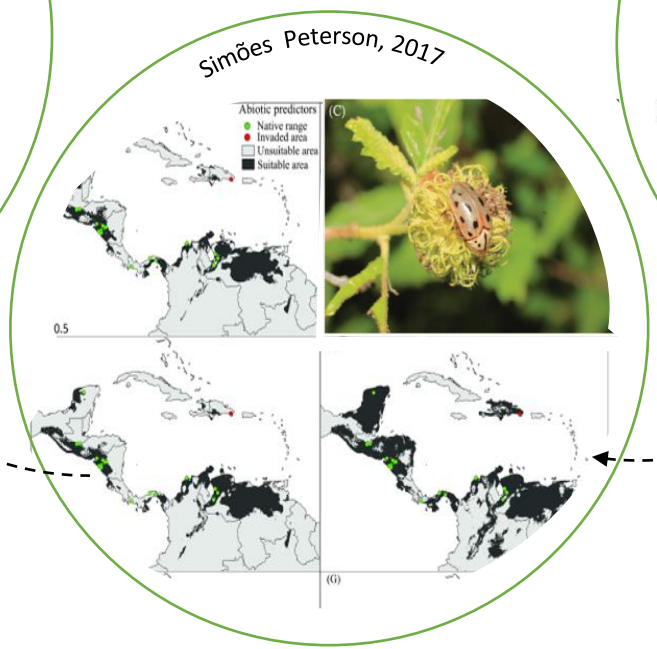
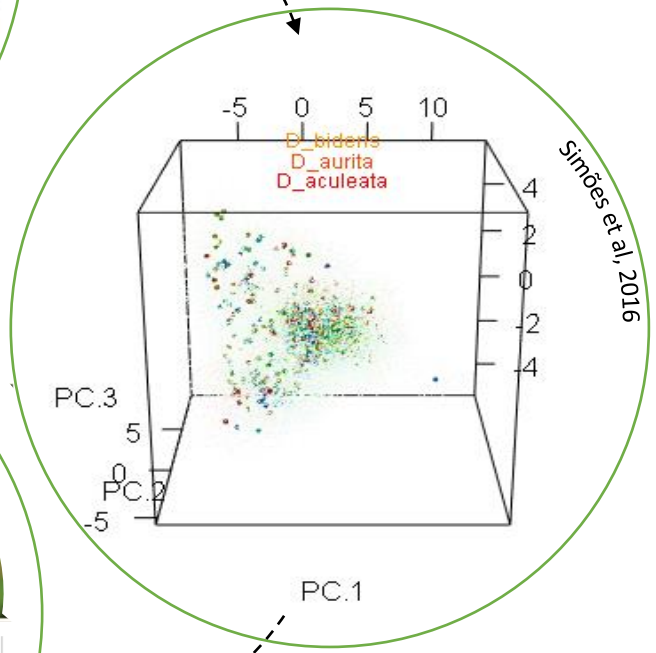
Morphology
Distribution
Ecology



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# Biological collections


USNM


MfN, Berlin


SNG, Gorlitz

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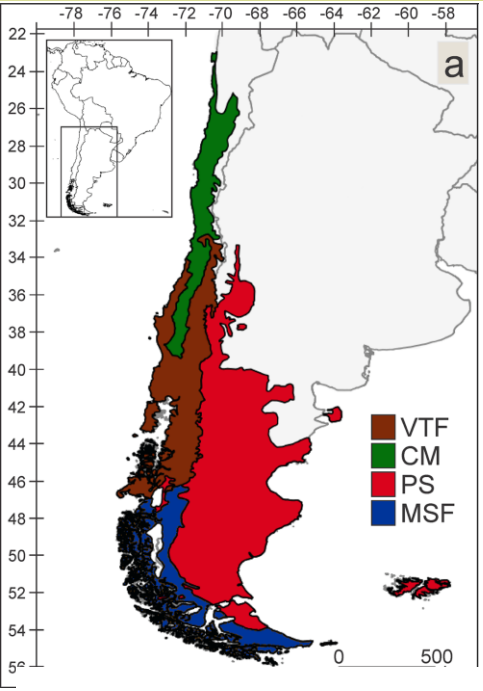
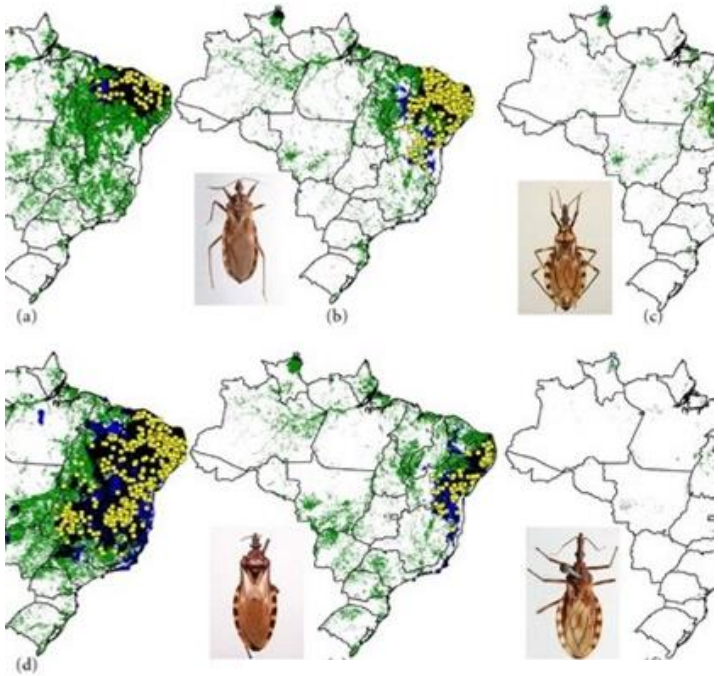
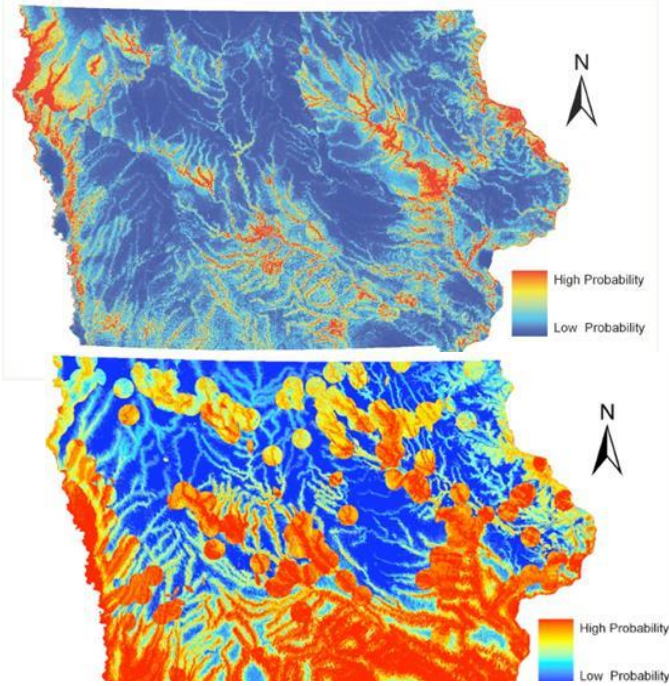
# Entomology and distributional ecology



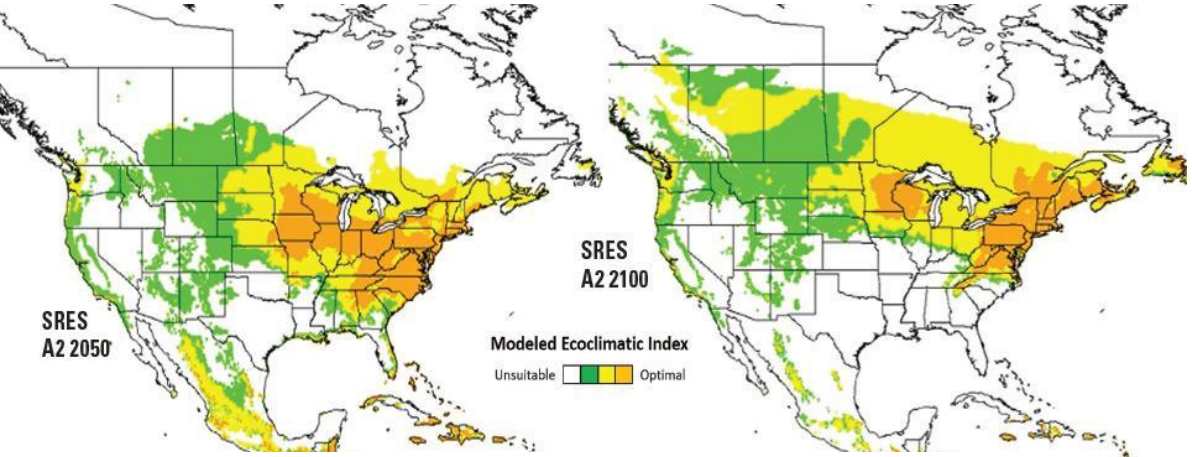

Montemayor et al 2017



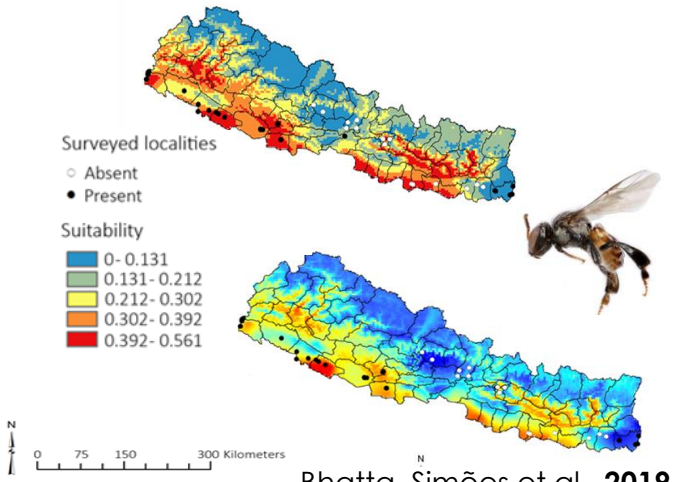

Gurgel Gonçalves et al 2012




Larson et al 2010

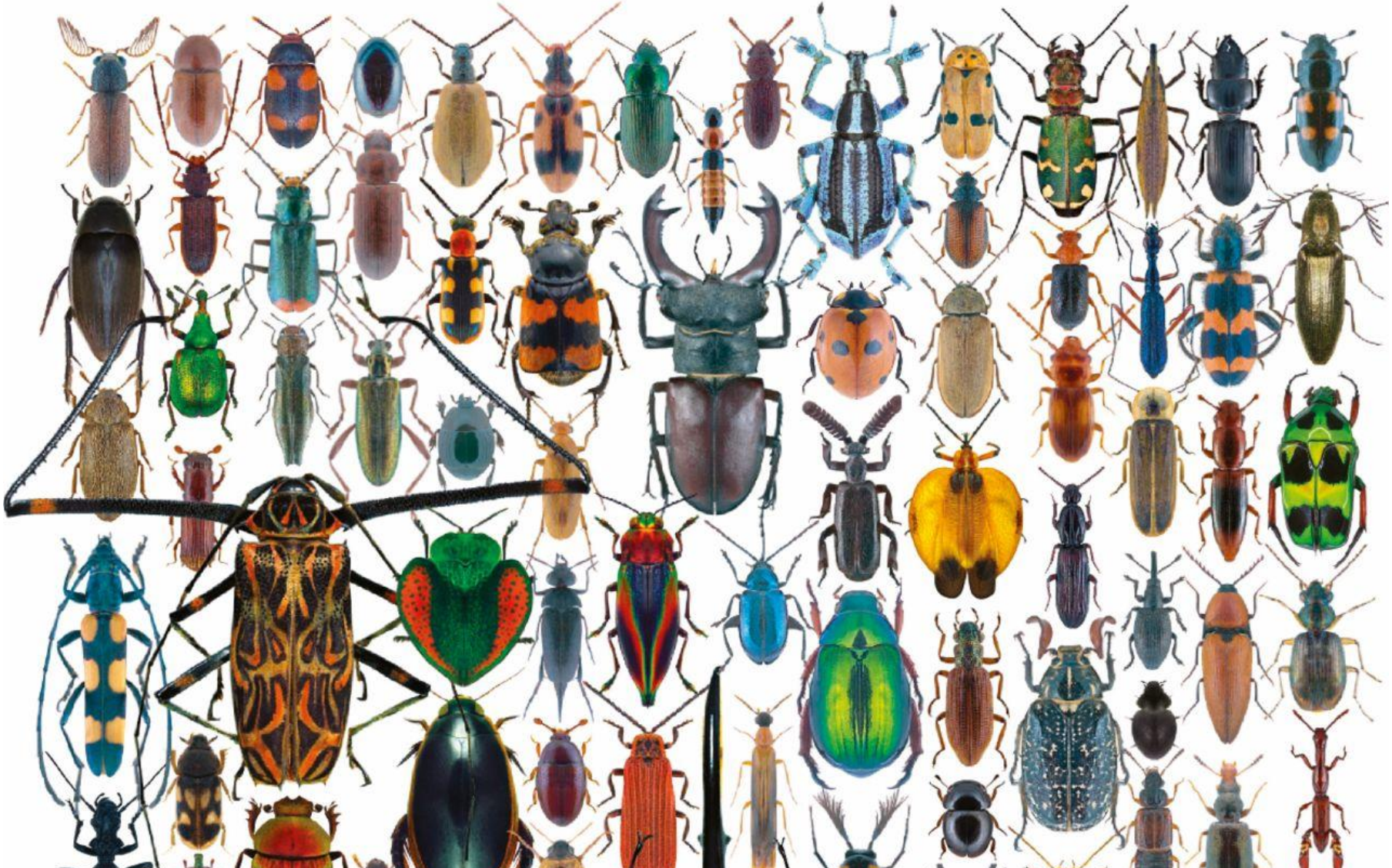



Source: Erica Kistner 2017, in Environmental Entomology)

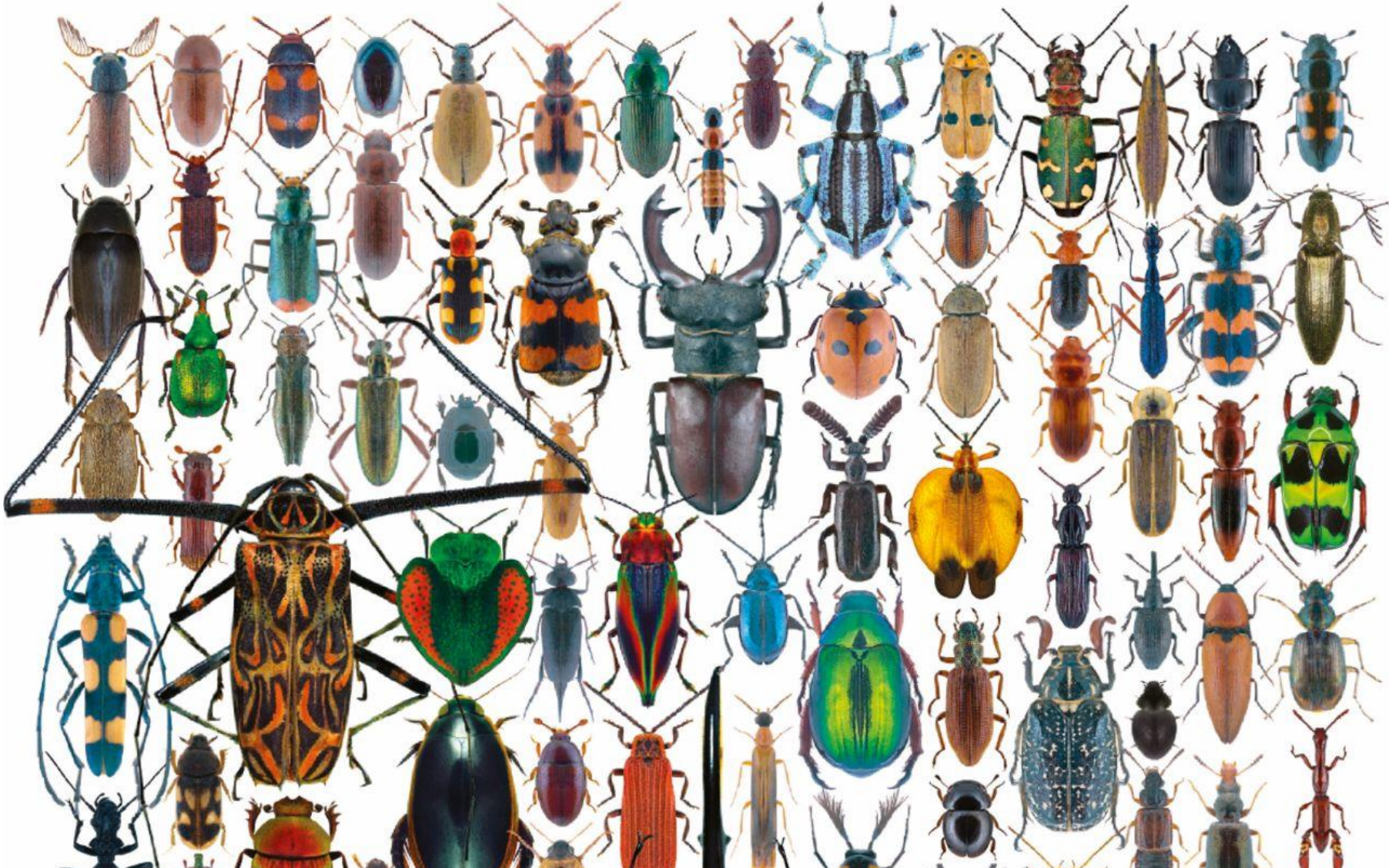



Bhatta, Simões et al., **2019**

# *Space: The Final Frontier*



# *Entomology*: *The Final Frontier*



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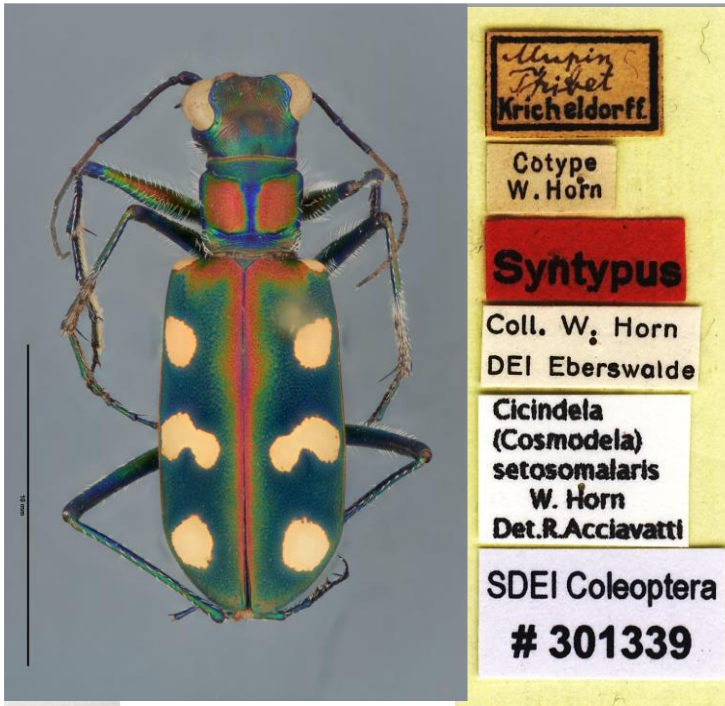
# Entomological collections





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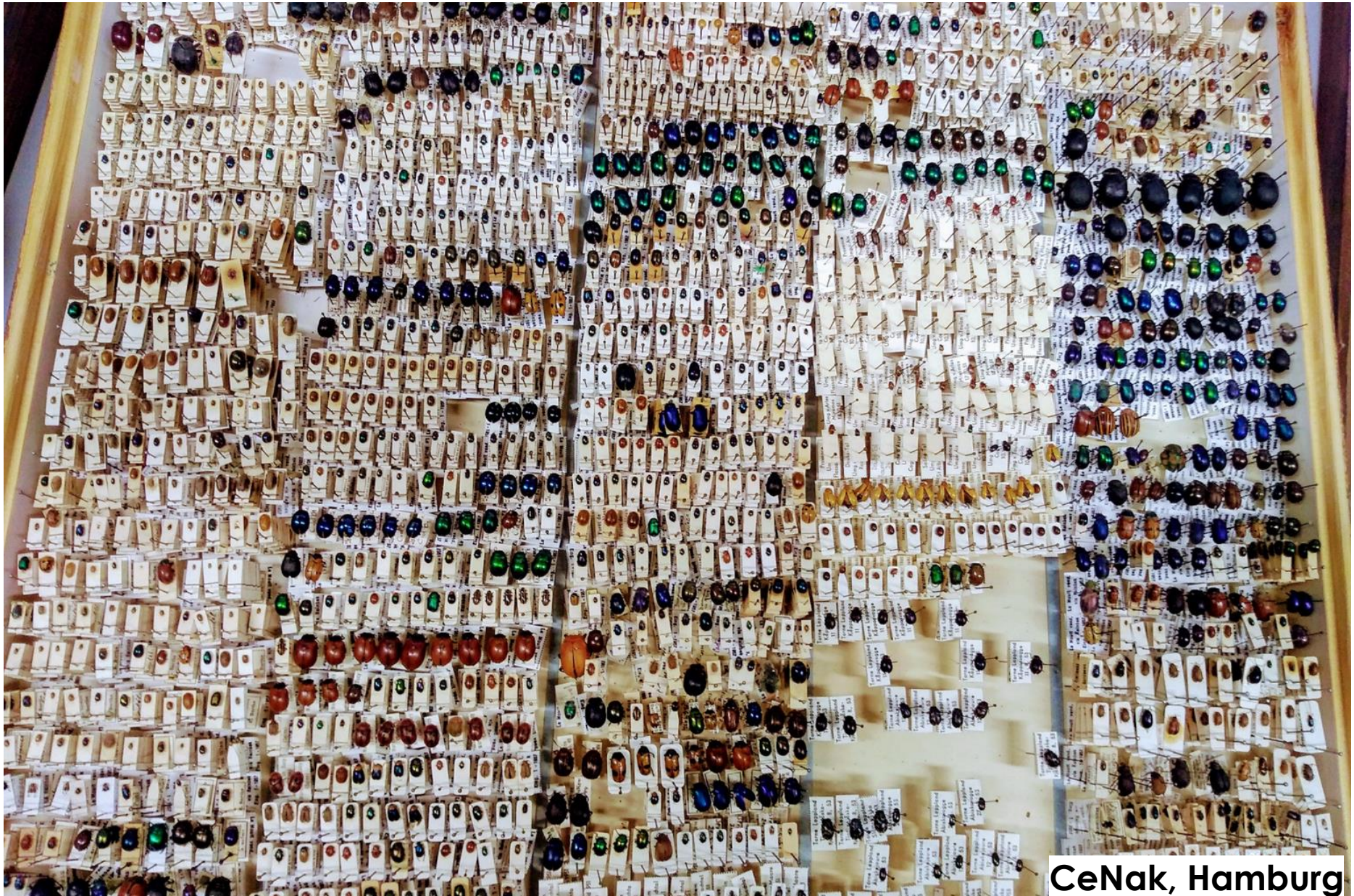
# Entomological collections



CeNak, Hamburg

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# Entomological collections


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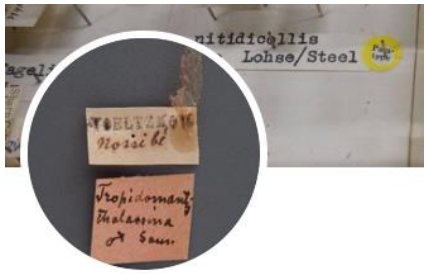
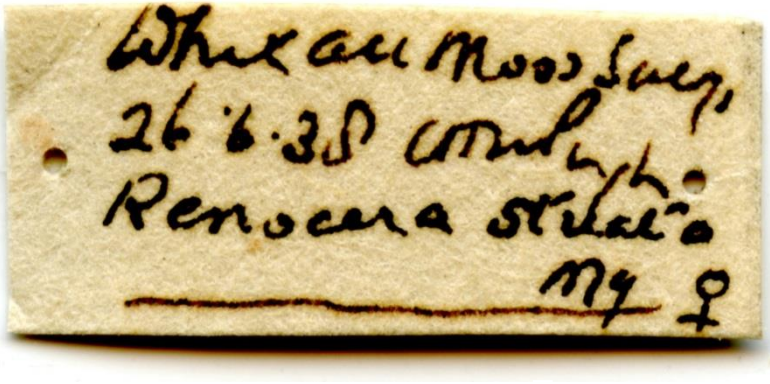
# Entomological collections

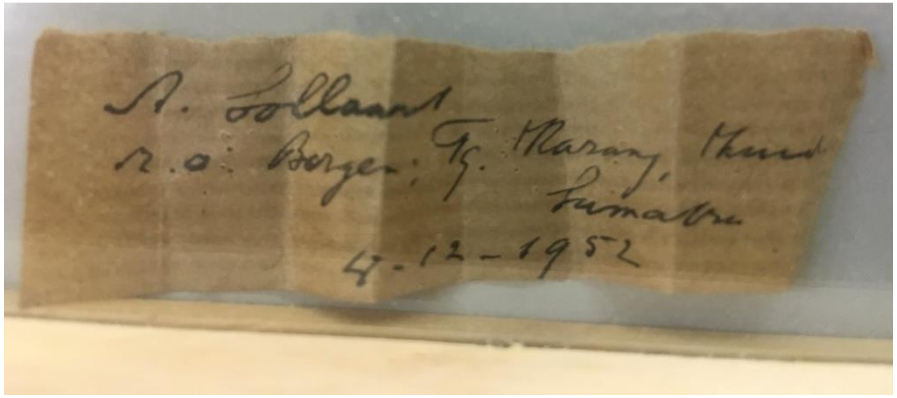


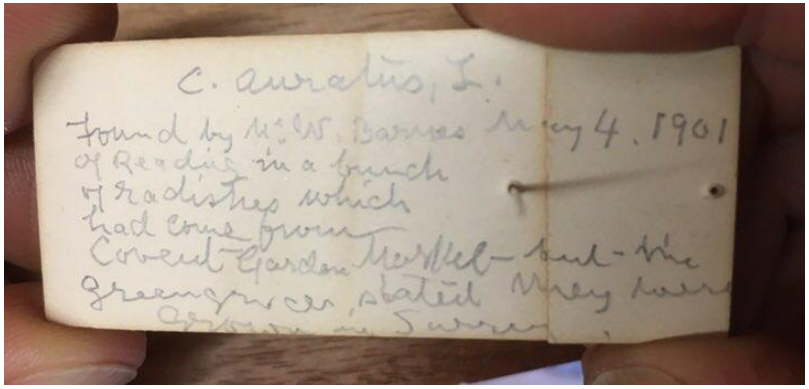

**EntomologyTranslator**
@EntoTranslator Follows you









# Digitization

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# Senckenberg Deutsches Entomologisches Institut (SDEI)

1886 **Deutsches Entomologisches Nationalmuseum (DENM)**

1911 **Deutsches Entomologisches Museum (DEM)**

1920 **Deutsches Entonomologisches Institut (DEI)**
German Entomological Institute

1943 **WW2: ***Mecklenburg

1950 **WW2: ***Friedrischhagen

1951 **German Academy of Agricultural Sciences**

1963 **Post-WW2: ***Eberswalde

1971 **Division of Taxonomy of Insects**

1989 **German Unification**
German Entomological Institute

Beck, L. A. (Ed.). (2018). *Zoological collections of Germany: The animal kingdom in its amazing plenty at museums and universities*. Springer.

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# Senckenberg Deutsches Entomologisches Institut (SDEI)

1992-1993 **Project Group in KAI**
German Entomological Institute

1994 **Project Group in Entomology**
University of Applied Science Eberswalde

1997 Registered Assoc. **German Entomological Institute (DEI)**

2000 Became **Department of the Center of Agricultural Sciences**

2008 Evaluation from ZALKF

2009 Became part of **Senckenberg : SDEI**

**Coleoptera (40%)**

1,7 million spec.

160,000 sp.

~14,000 types

**3 million** pin. Insect.

+ alcohol collection

**25,000** type specimens

**>100** collections

Beck, L. A. (Ed.). (2018). *Zoological collections of Germany: The animal kingdom in its amazing plenty at museums and universities*. Springer.

# EdiCall: CARAB project


**Digitization** and **standardization** in Senckenberg (SNG)

Dresden, Müncheberg, Frankfurt am Main

Types

Pilot Project

Create Workflow

Maximize Accessibility

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Senckenberg Deutsches Entomologisches Institut (SDEI)

Collections:

**Col. Lucas von Heyden**
(Coll. L. v. Heyden, ded. DEI 1915)

**Col. Otto Leonhard**
(Coll. O. Leonhard, ded. DEI 1929)

**Col. B. Rensch**
(Coll. B. Rensch, via F. Weber, ded. SDEI 2011)

**Col. Dieter Hülbert**
(Coll. D. Hülbert, ex ZALF, LSA; ded. DEI 2006)

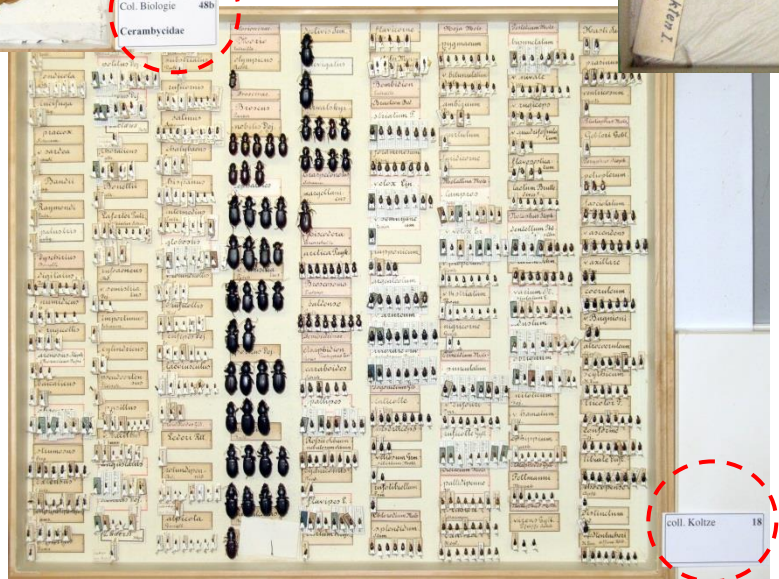
**Col. F. Weber**
(Coll. F. Weber; ded. SDEI 2011)

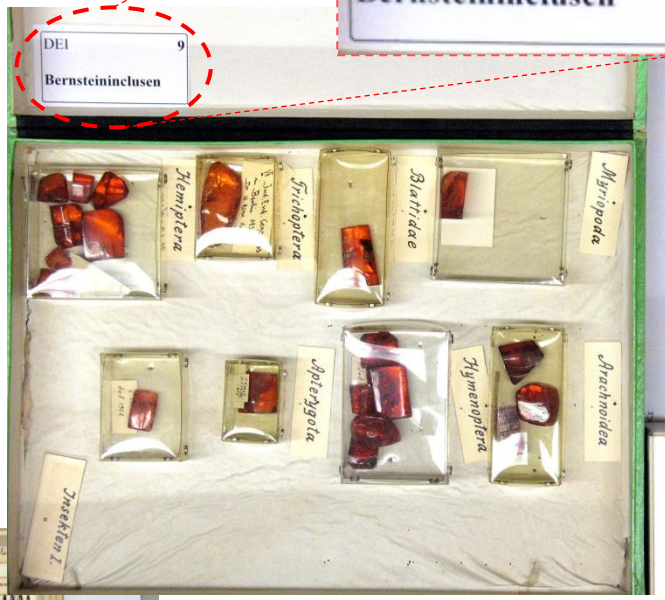
**Col. M. Moeck**
(Coll. M. Moeck, ded. SDEI 2014)

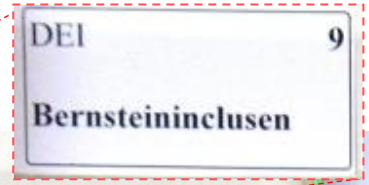
**Col. Peter Jaros**
(Coll. P. Jaros, ded. SDEI 2015)

Digitization process

**“Inventory 2009”**

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Senckenberg Deutsches Entomologisches Institut (SDEI)

Digitization process

**“Inventory 2009”**



## Assembling Collections

- Creation of location labels
- Creation of determination labels
- Preparation
- Systematic sorting and classification

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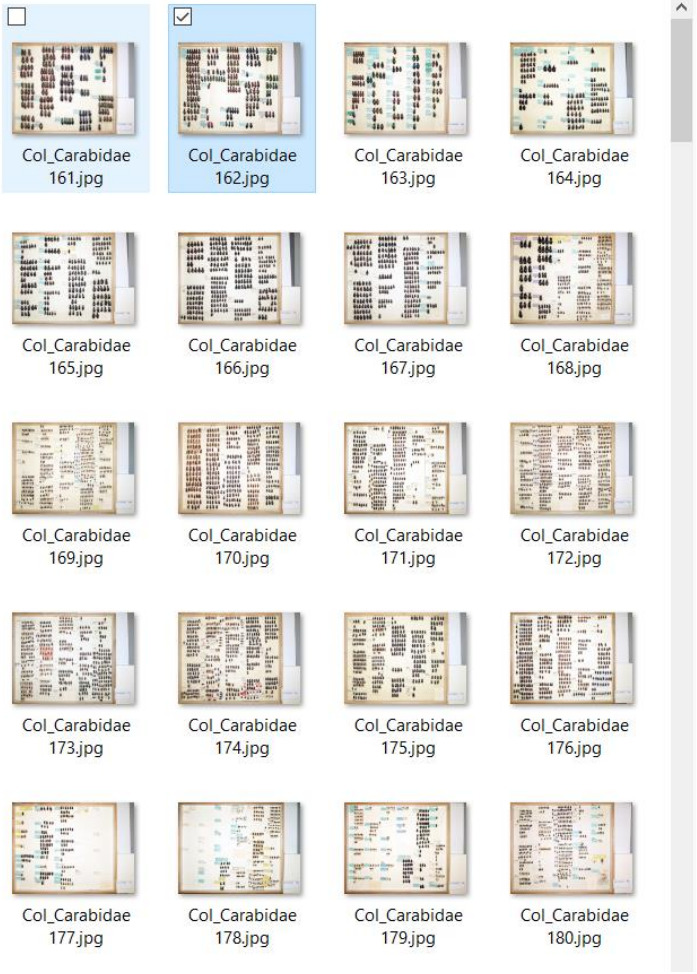
Senckenberg Deutsches Entomologisches Institut (SDEI)

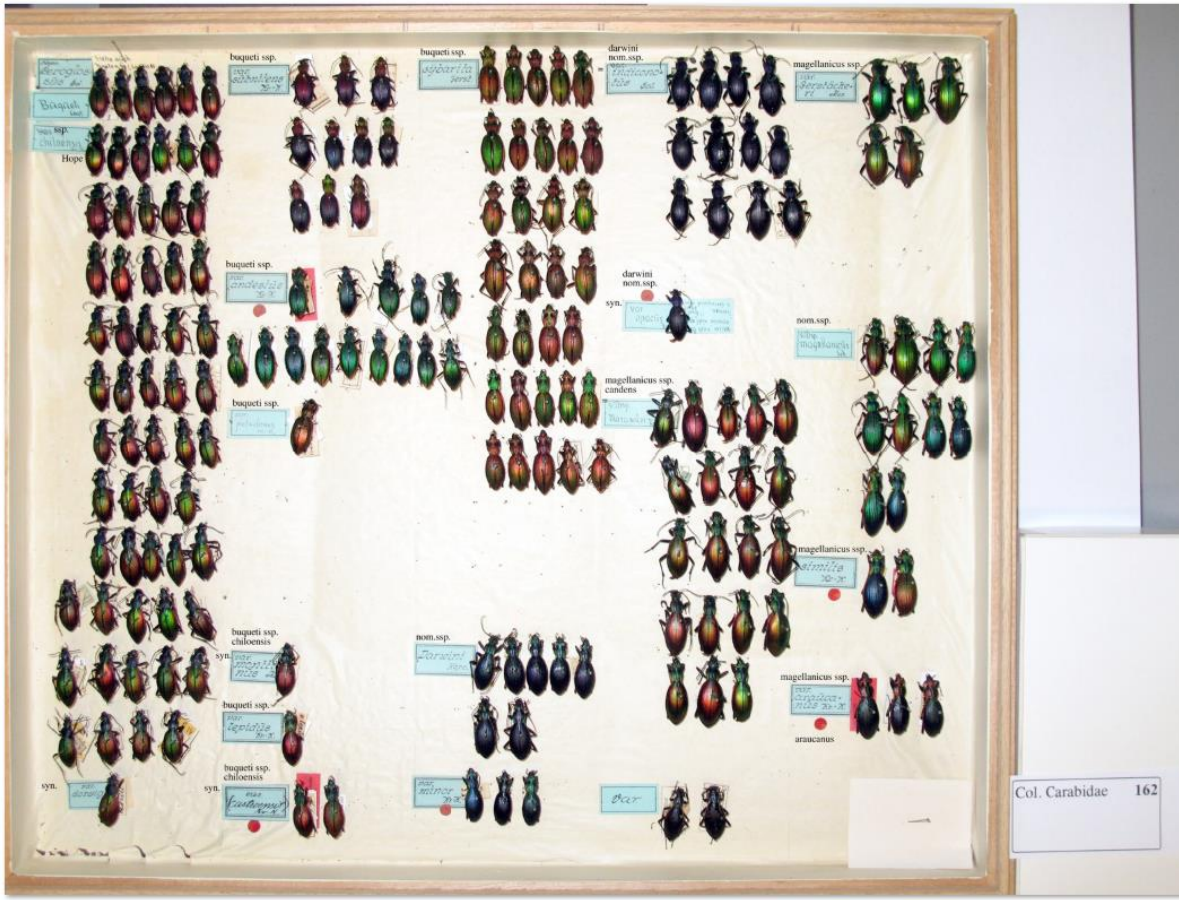
**Digitization** process

Number of species

Number of specimens

Number of types



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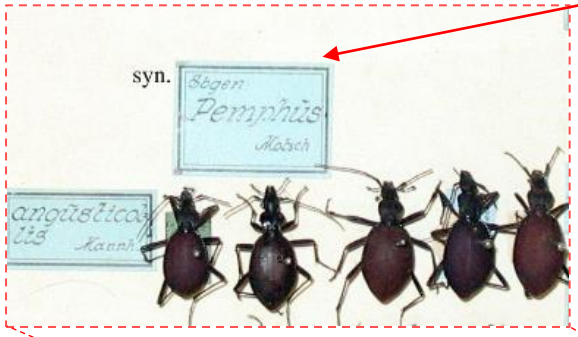
# **Taxonomic assessment**: Lutz Behne



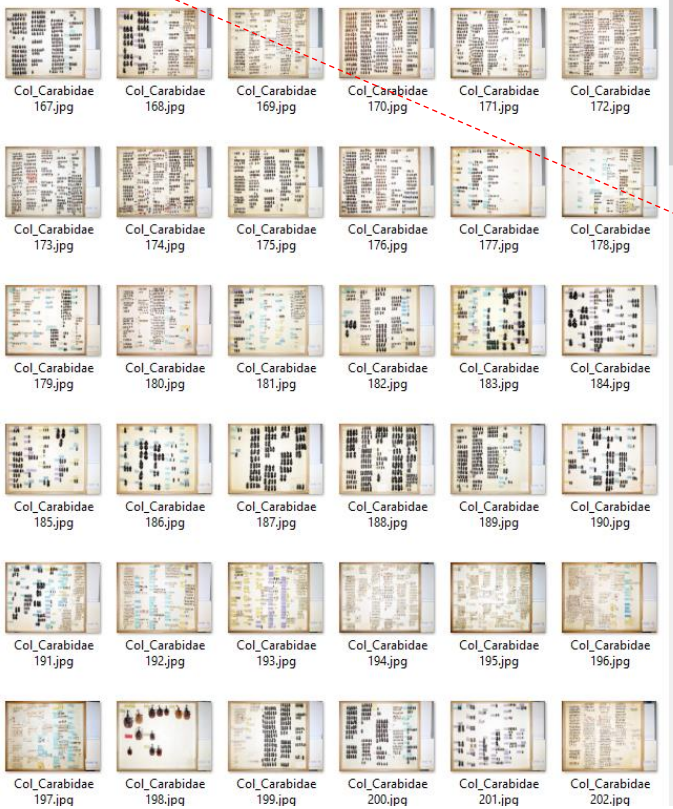

**Synonym**

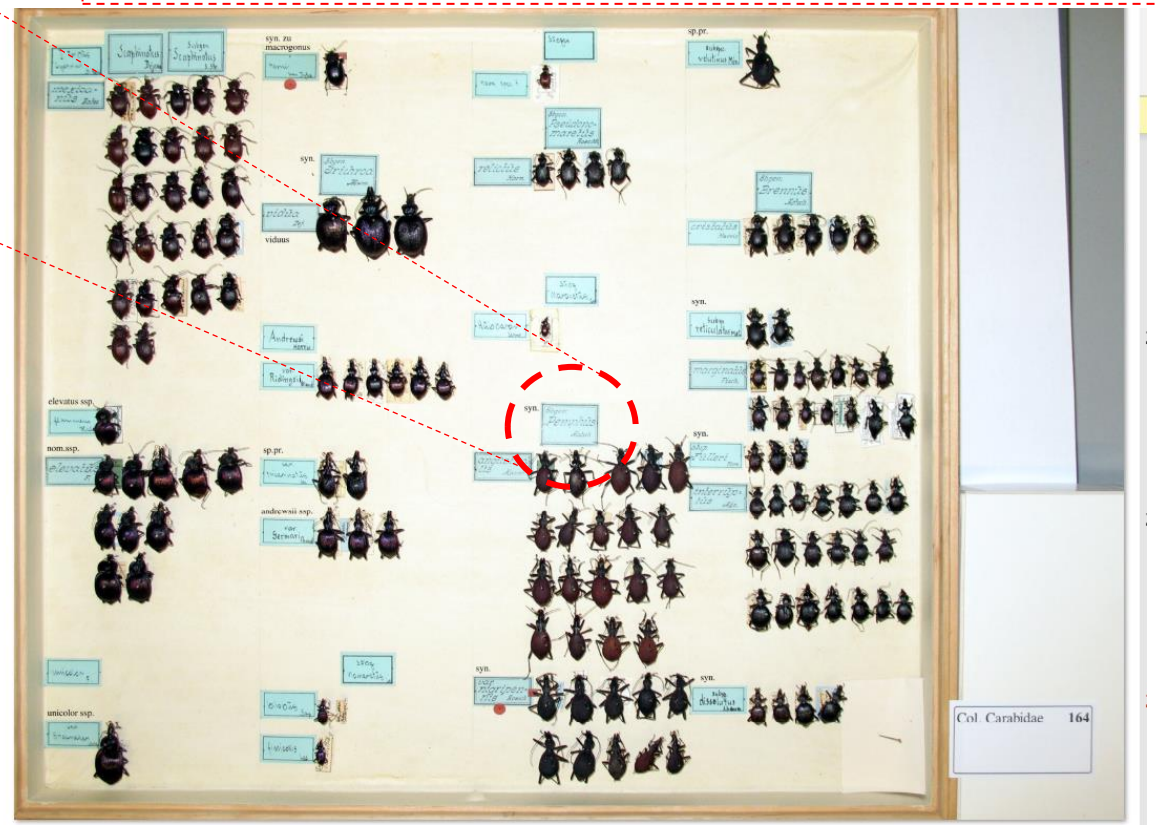
**Taxonomic Revision of the genus *Mesomphalia* Hope, 1839 (Insecta, Coleoptera, Chrysomelidae)**

MARIANNA V. P. SIMÕES[1,3] & MARCELA L. MONNÉ [2,3]
[1]*Division of Entomology, Biodiversity Research Institute & Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, Kansas 66045, U. S. A. E-mail: mariannavpsimoes@gmail.com*
[2]*Museu Nacional, Universidade Federal do Rio de Janeiro. Quinta da Boa Vista, São Cristóvão, 20940-040, Rio de Janeiro, Brazil.*
[3]*Fellow of the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)*

***Mesomphalia gibbosa* (Fabricius, 1781)**
(Figs. 1–54, 91–97, 156, 158)

*Cassida gibbosa* Fabricius, 1781: 112; 1787: 65; 1792: 302; 1801: 403; Gmelin, 1790: 1638; Olivier, 1790: 388; 1808: 928; Herbst, 1799: 346; Schönherr, 1817: 225.
*Mesomphalia gibbosa:* Hope,1839: 94; 1840: 91; Boheman, 1850: 223; 1856: 38; 1862: 102; Gemminger & Harold, 1876: 3632; Wagener, 1881: 63; Spaeth, 1901: 339; 1914: 33; Blackwelder, 1946: 737; Borowiec, 1996: 192; 1999: 117; Simões & Monné, 2008: 713; Flinte *et al.*, 2008: 200; 2009: 589; Borowiec & Takizawa, 2011: 448.
*Stolas gibbosa:* Haitlinger, 1991: 397.



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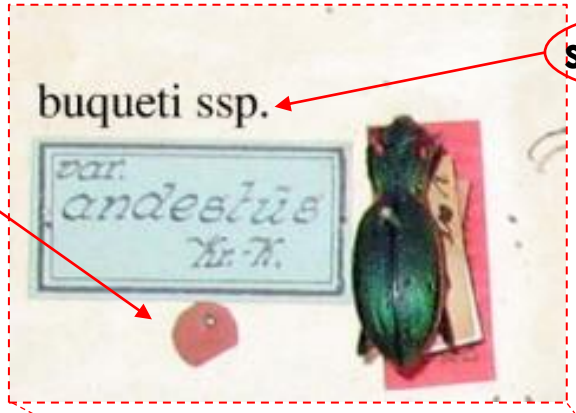
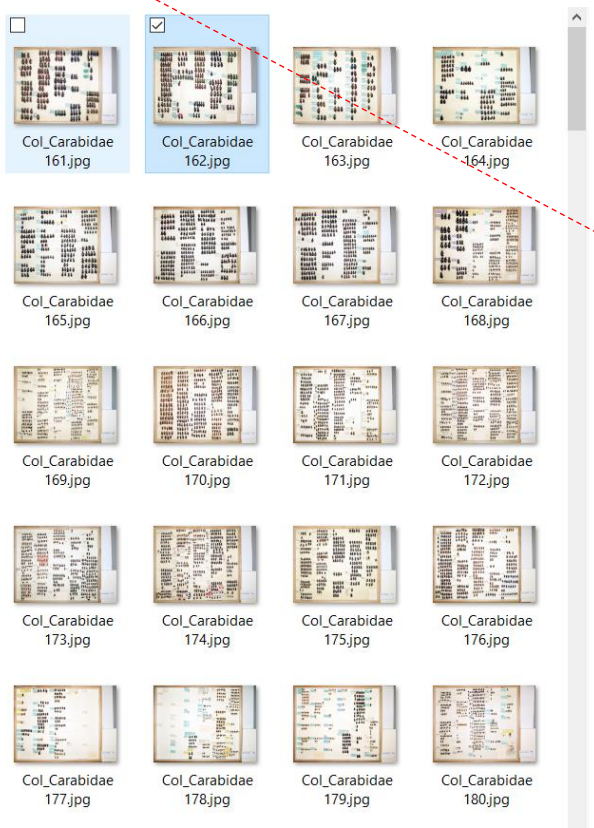
**Taxonomic assessment**: Lutz Behne

**subspecies**

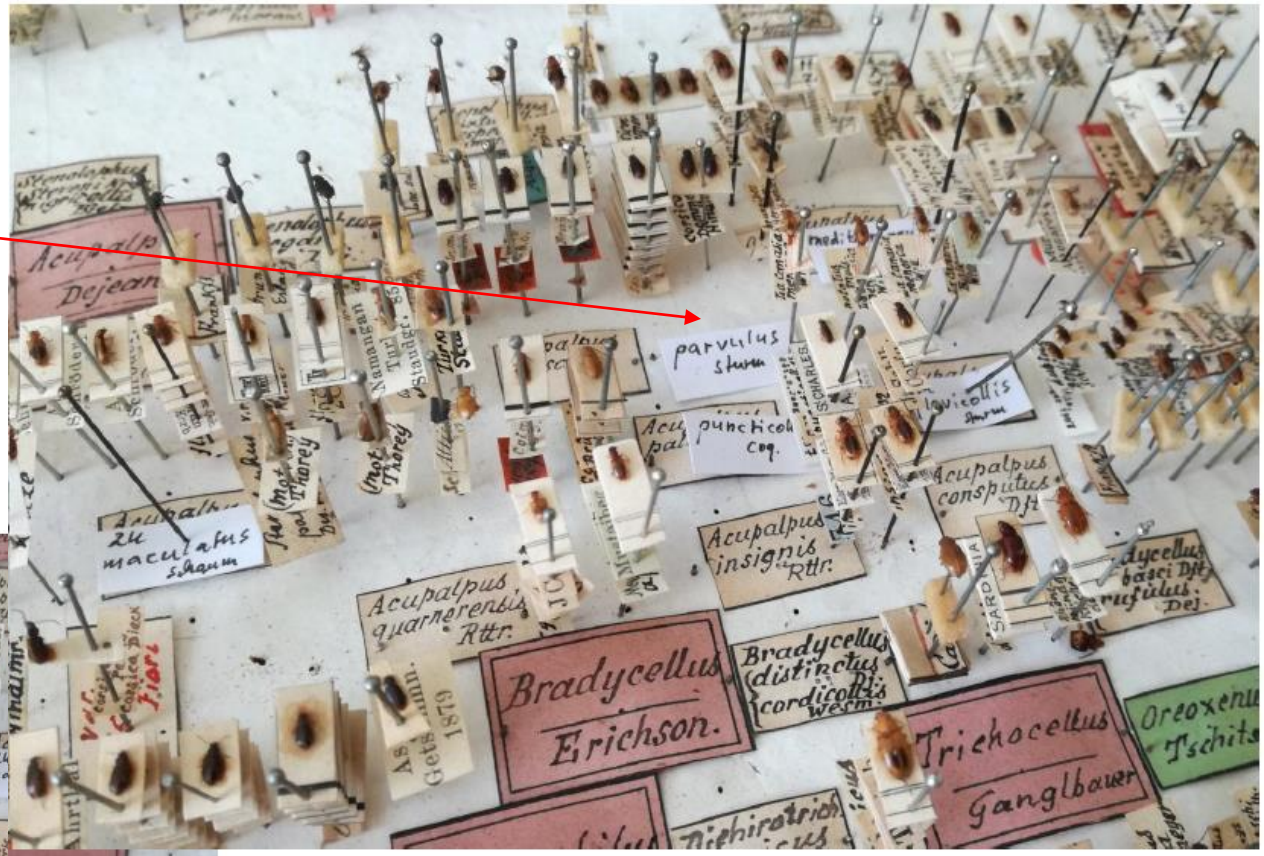
**Type**




**Taxonomic assessment**: Lutz Behne

## Taxonomic Corrections

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# Database

## Paradox

Code for species

Code + Class

Table: Col_spec.DB

| | Syst_cod | Syst_cod_Fam | Code Luchtmihi | Suborder_nr | Suborder | Fam_gr_nr | Fam_gruppe | Fa_nr | FAMILY | UF_n | SUBFAM | TRIB_n | TRIBUS | Subtr | SUBTRIBUS | G_nr | GENUS | UG_nr | SUBGEN | Unter | Art_n | SPECIES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1727 | 142205123953 | | 40 | Adephaga | | | 50 | Carabidae | 50 | Cicindelinae | 20 | Cicindelini | 20 | Cicindelina | | Cylindera | | Ifasina | x | | ramenensis |
| 2 | 18033 | 142205123818 | | 50 | Polyphaga | 20 | Staphylinoidea | 60 | Staphylinidae | 310 | Paederinae | | | | | | Pinobius | | | | | vicinus |
| 3 | 18255 | 142205123826 | | 50 | Polyphaga | 20 | Staphylinoidea | 60 | Staphylinidae | 320 | Staphylininae | | | | | | Platyprosopus | | | | | laevicollis |
| 4 | 18719 | 142205123958 | | 40 | Adephaga | | | 50 | Carabidae | 50 | Cicindelinae | 30 | Collyridini | 10 | Collyrina | | Collyris | | | x | | dormeri |
| 5 | 19054 | 172145220110 | | 40 | Adephaga | | | 50 | Carabidae | 50 | Cicindelinae | 60 | Megacephalini | 20 | Megacephalina | | Pseudotetracha | | Pseudotetracha | x | | corpulenta |
| 6 | 19265 | 142205123954 | | 40 | Adephaga | | | 50 | Carabidae | 50 | Cicindelinae | 20 | Cicindelini | 30 | Dromicina | | Dromica | | | x | | jordani |
| 7 | 19290 | 142205123954 | | 40 | Adephaga | | | 50 | Carabidae | 50 | Cicindelinae | 20 | Cicindelini | 30 | Dromicina | | Dromica | | | x | | spectabilis |
| 8 | 19291 | 142205123954 | | 40 | Adephaga | | | 50 | Carabidae | 50 | Cicindelinae | 20 | Cicindelini | 30 | Dromicina | | Dromica | | | x | | spectabilis |
| 9 | 19301 | 142205123954 | | 40 | Adephaga | | | 50 | Carabidae | 50 | Cicindelinae | 20 | Cicindelini | 30 | Dromicina | | Dromica | | | x | | prolongatesignata |
| 10 | 19315 | 142205123954 | | 40 | Adephaga | | | 50 | Carabidae | 50 | Cicindelinae | 20 | Cicindelini | 30 | Dromicina | | Dromica | | | x | | foveolata |

..If types are present

Table: Col_syn.DB

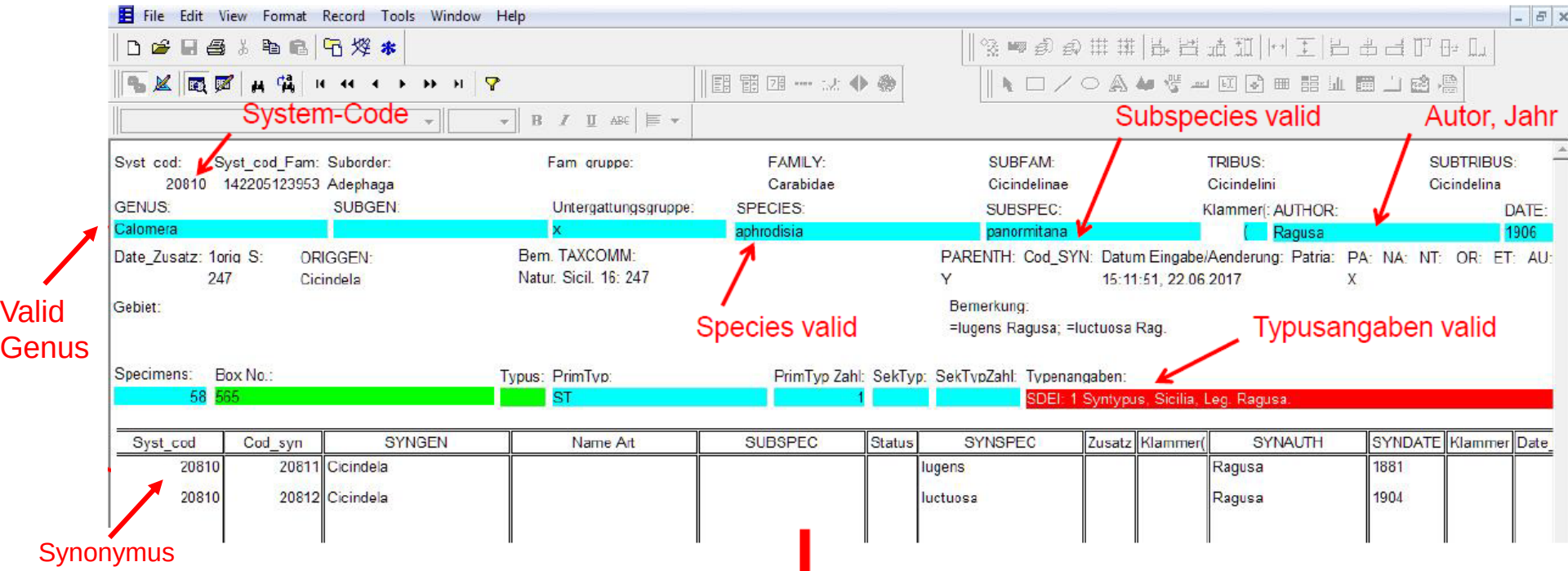
| | Syst_cod | Cod_syn | FAMILY | SUBFAM | GENUS | SUBGEN | SPECIES | SUBSPEC | KI | AUTHOR | DATE | Kla | SYNGEN | Name Art_Syn | SUBSPEC_Sy | Statu | SYNSPEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19054 | 1012831 | Carabidae | Cicindelinae | Pseudotetracha | Pseudotetrach | corpulenta | | ( | W. Horn | 1907 | ) | Megacephala | | | | elongata |
| 2 | 19054 | 1014900 | Chrysomelidae | Chrysomelinae | Chysolina | Chalcoidea | pusa | | ( | Lopatin | 1962 | | Chrysomela | | | | purkynei |
| 3 | 20810 | 20811 | Carabidae | Cicindelinae | Calomera | | aphrodisia | panormitana | ( | Ragusa | 1906 | ) | Cicindela | | | | lugens |
| 4 | 20810 | 20812 | Carabidae | Cicindelinae | Calomera | | aphrodisia | panormitana | ( | Ragusa | 1906 | ) | Cicindela | | | | luctuosa |
| 5 | 1000071 | 192608150323 | Staphylinidae | Paederinae | Achenium | | nigriventre | | | Fairmaire | 1871 | | Achenium | | | | lusitanicum |
| 6 | 1000194 | 17645 | Staphylinidae | Omaliinae | Eusphalerum | Eusphalerum | africanum | | ( | Roubal | 1915 | ) | Anthobium | | | | tibiale |
| 7 | 1000210 | 211 | Staphylinidae | Proteininae | Megarthrus | | nigrinus | | | Sahlberg | 1876 | | Megarthrus | | | | sahlbergi |
| 8 | 1000213 | 17678 | Staphylinidae | Omaliinae | Phloeostiba | | lapponica | | ( | Zetterstedt | 1838 | ) | Phloeonomus | | | | conformis |

Code for species

Code for synonyms

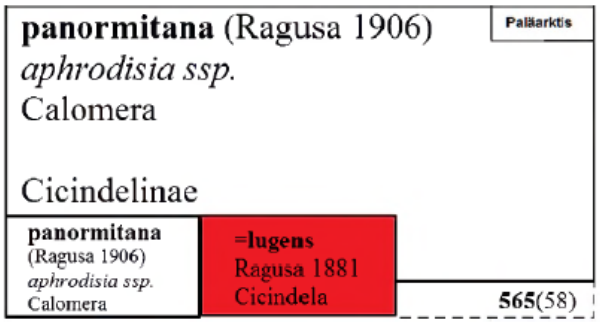
## Database

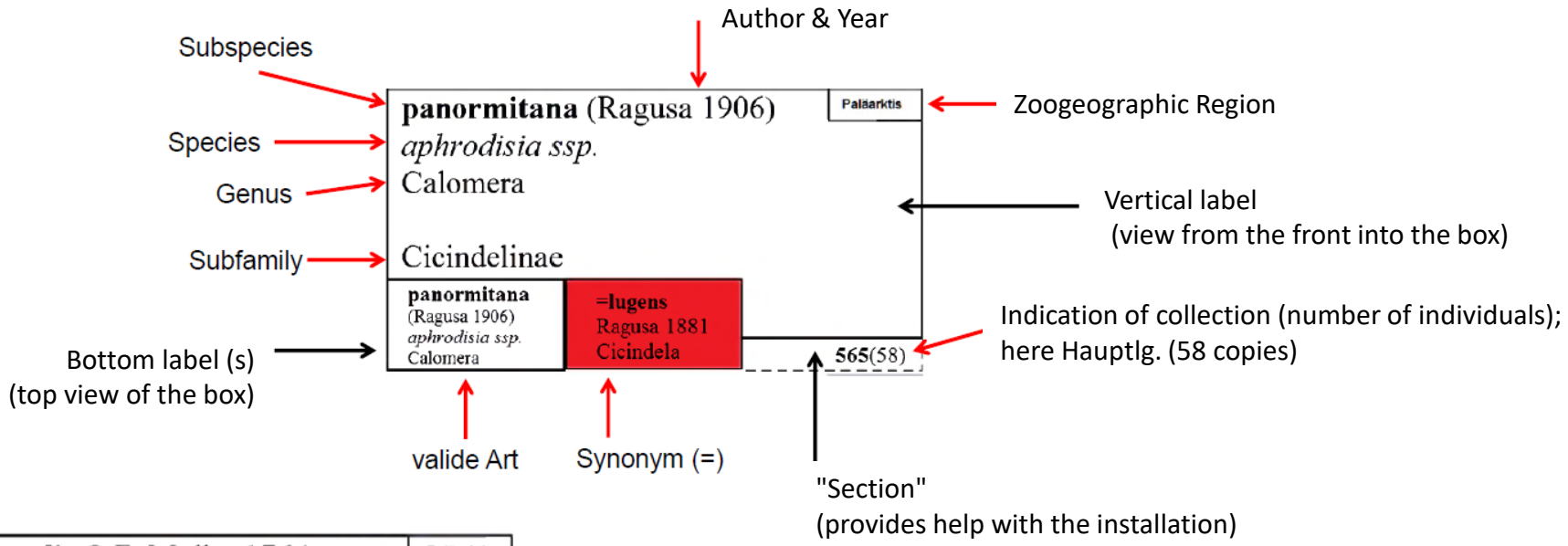
# Paradox

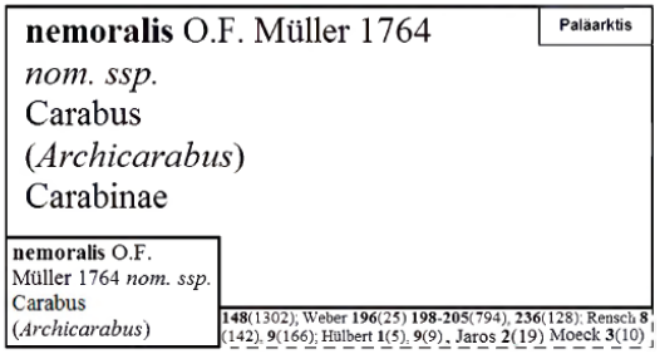



| Syst_cod | Cod_syn | SYNGEN | Name Art | SUBSPEC | Status | SYNSPEC | Zusatz | Klammer( | SYNAUTH | SYNDATE | Klammer | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20810 | 20811 | Cicindela | | | | lugens | | | Ragusa | 1881 | | |
| 20810 | 20812 | Cicindela | | | | luctuosa | | | Ragusa | 1904 | | |

**Labels follow Database structure**



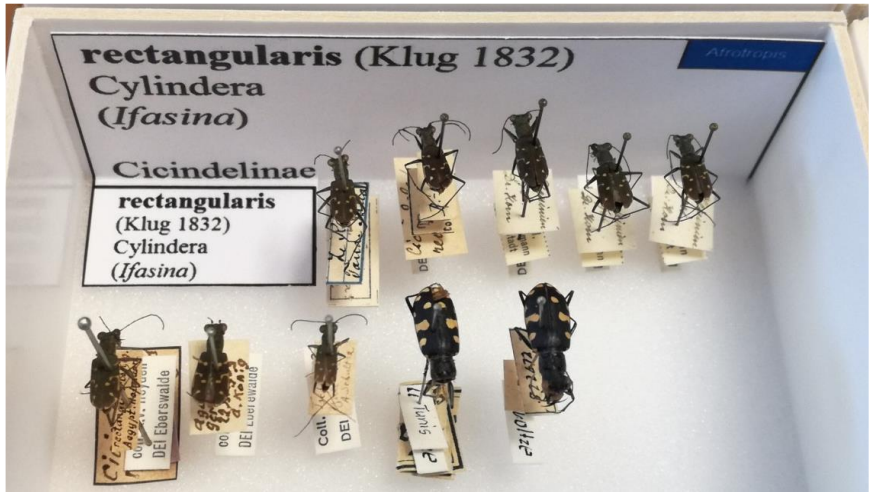



Hauptslg. K 148 (1302 Ex.); Weber K 196 (25 Ex.), K 198-205 (794 Ex.), K 236 (128 Ex.); Rensch K 8 (142 Ex.), K 9 (166 Ex.); Hülbert K 1 (5 Ex.), K 9 (9 Ex.); Jaros K 2 (19 Ex.); Moeck K 3 (10 Ex.)

## Collection Organization

- Unit-tray system
- Creation of determination labels
- Preparation
- Systematic sorting and classification





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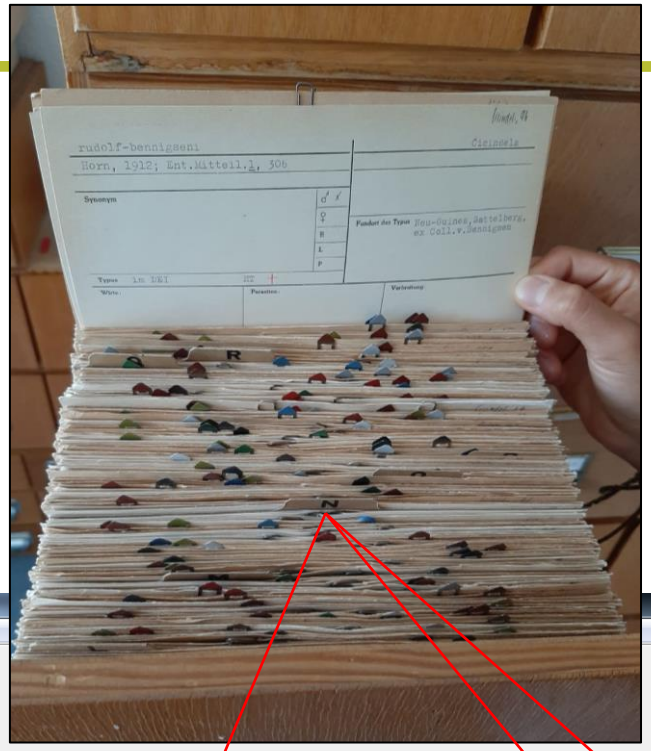
Senckenberg Deutsches Entomologisches Institut (SDEI)

## Type pictures

# Which is the type…

# ….or, which type is it?




Paradox

File Edit View Format Record Tools Window Help

Table : Col_spec.DB

| | OR | ET | AU | Bem. TAXCOMM | Typenangaben | Typus | PrimTy | Prim | SekTy | SekTy |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | X | | Tiger beetles of the Madagascan region.... 1-429 | SDEI: $ Holotypus, Antsebetsienne, VI.[19]33, leg. Mellis; 5 Paratypen dto...XI.[19]33; 4 Paratypen, NW Madagascar, R. Ramena, XII.1 | | HT | 1 | PT | 11 |
| 2 | X | | | Arch. Nat. 25, 118 | SDEI: Lectotypus (des. Assing), India orientali., leg. Helfer, coll. Kraatz | | LT | 1 | | |
| 3 | X | | | Arch. Nat. 25, 114 | SDEI: Lectotypus, 1 Paralectotypus (des. Bordoni), India or., leg. Bacon. | | LT | 1 | PLT | 1 |
| 4 | X | | | Dtsch. Ent. Ztschr., 196 | SDEI: $ Holotypus, Ind. or., ex coll. Dormer. | | HT | 1 | | |
| 5 | | | X | Not. Leyd. Mus. 29, 63 | SDEI: § Holotypus, Queensland borealis, in coll. Horn; [NR. 18, durch Bates] | | HT | 1 | | |
| 6 | | X | | Dtsch. Ent. Ztschr., 53 | SDEI: $ Paratypus, Lindi, XII.1896, leg. Reimer, coll. Horn. | | | | PT | 1 |
| 7 | | X | | Not. Leyd. Mus. 19: 236-237 | SDEI: Lectotypus (des. Schüle), British Afrika, Blantyre, leg. de Lange, coll. Horn. | | LT | 1 | | |
| 8 | | X | | Stett. Ent. Ztg. 68: 331 | SDEI: Lectotypus, 5 Paralectotypen (des. Schüle), E. Afrika, Beira, II., III, IV.1906, leg. Sheppard, coll. Horn. | | LT | 1 | PLT | 5 |
| 9 | | X | | Ent. Blätter 21: 136 | SDEI: 1 Lectotypus, 3 Paralectotypen (des. Schüle), Kapiri, IX.1912, Miss. Agric., ex Museé du Congo Belge; Katanga Distr., centr. Afri | | LT | 1 | PLT | 3 |
| 10 | | X | | Trans. S. Afr. Phil. Soc. 4, 71 | SDEI: $ Holotypus, ohne Fundort, 62. Lake N'Gàmi Region (wahrscheinlich der Fundort), coll. Andersson. | | HT | 1 | | |
| 11 | | X | | Trans. S. Afr. Phil. Soc. 7, 90 | SDEI: Lectotypus, 1 Paralectotypus (des. Schüle), Natal: 3 Ex. Escurt; 2 Ex. Frere; 1 Ex. ohne Fundort, Nr. 29; ex coll. Péringuey. | | LT | 1 | PLT | 1 |
| 12 | | X | | Stett. Ent. Ztg. 90, 317 | SDEI: 1 § Holotypus, Katanga. | | HT | 1 | | |
| 13 | | X | | Trans. S. Afric. Philos. Soc. 6(2): 4 | SDEI: 1 Syntypus, ohne Fundort durch Péringuey, coll. Horn. | | ST | 1 | | |
| 14 | | X | | Trans. Ent. Soc. London, 448 | SDEI: 1 Syntypus, ohne Fundort, Nr. 30, ex coll. Péringuey. | | ST | 1 | | |
| 15 | X | | | Arch. Naturg. 79(A 11): 25 | SDEI: 5 Syntypen, Celebes, leg, Kibler, Tondkallace, coll. Horn. | | ST | 5 | | |

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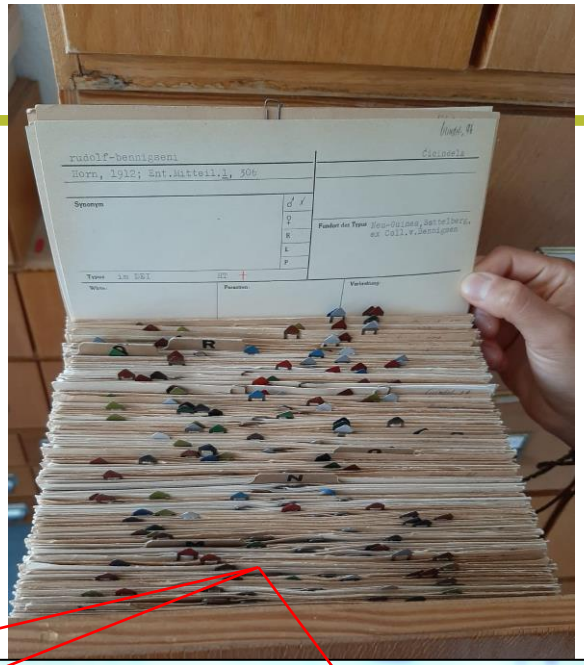
## Type pictures

# Which is the type…

# ….or, which type is it?



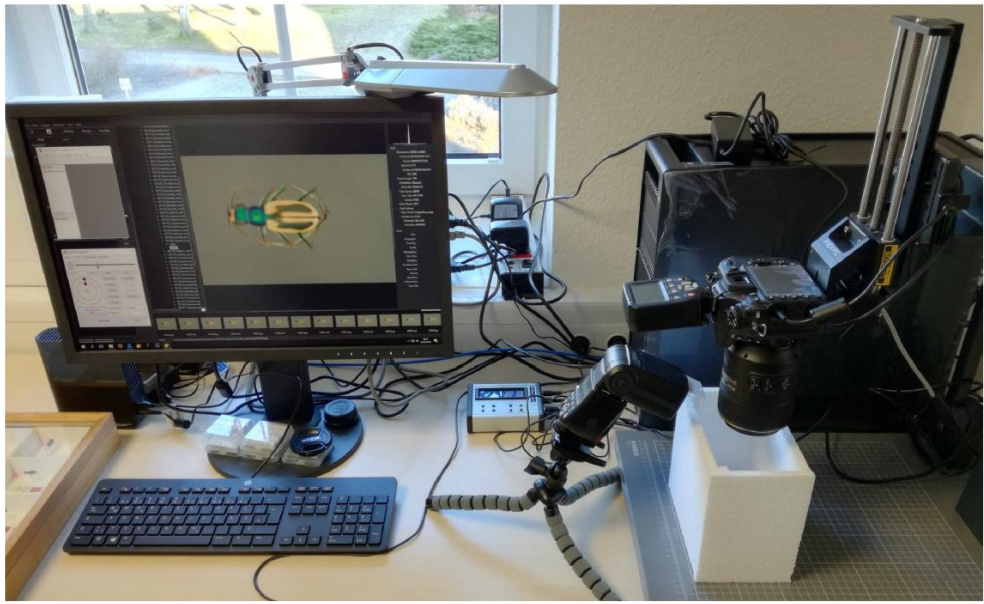
Typenfotos Carabidae (11.07.2018).xlsx - Microsoft Excel

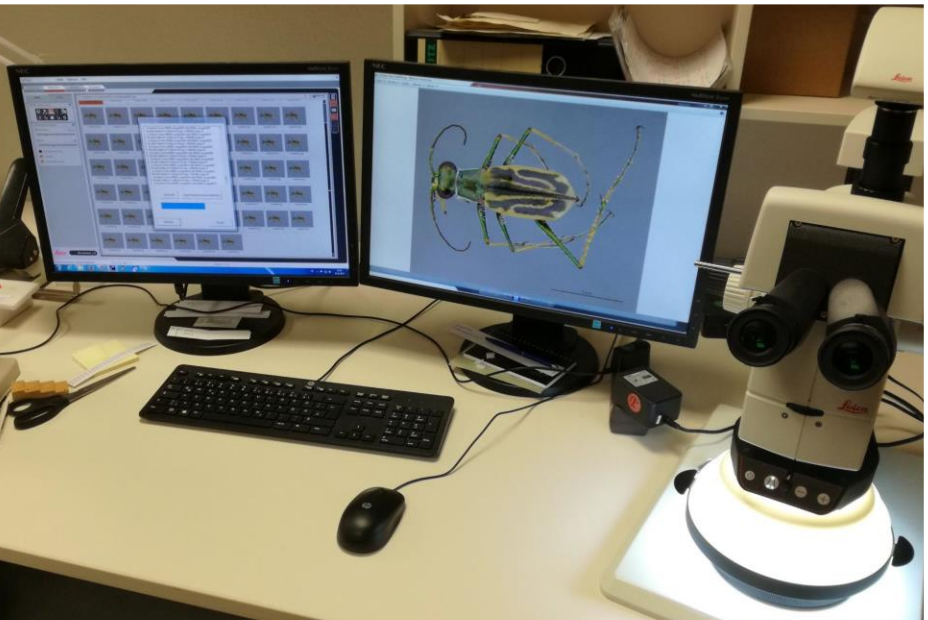
| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Type-Foto- | | total number | label image | dorsal | lateral | image of fragments | | Setup | Scale | box number | Name Foto | | | | | | | | |
| 2 | Nr. | Type | of pr.types | / scann | image | image | or genitalia | sex | Magnification | px/mm | (new) | Genus | Species | Subspecies/Var./Ab | Kl. auf | Author | Date | Kl. zu | Syst_cod | Cod_syn |
| 3 | 302423 | ST | 1 | 1 | 1 | | | male? | w-2 | 127 | 1 | Anthia | andersonii | bennigseni | | Sternberg | 1906 | | 162601233616 | |
| 4 | 302424 | ST | 1 | 1 | 1 | | | female | w-16 | 159 | 2 | Anthia | bucolica | | | Kolbe | 1894 | | 162701234312 | |
| 5 | 302425 | ST | 1 | 1 | 1 | | | male | w-2 | 127 | 3 | Anthia | calva | | | Sternberg | 1907 | | 162701005311 | |
| 6 | 302426 | ST | 1 | 1 | 1 | | | male | w-25 | 102 | 6 | Anthia | aequecostata | | | Sternberg | 1907 | | 162701000717 | 162701004511 |
| 7 | 302427 | ST | 1 | 1 | 1 | | | female | w-14 | 181 | 7 | Anthia | galla | lesnei | | Sternberg | 1906 | | 162701005718 | |
| 8 | 302428 | ST | 1 | 1 | 1 | | | female | w-2 | 127 | 10 | Anthia | grandis | | | Sternberg | 1906 | | 162601234112 | 162601234818 |
| 9 | 302429 | i.l. | 1 | 1 | 1 | | | female | w-1 | 254 | 19 | Eccoptoptera | phila | | | Kolbe | i.l. | | 162901012313 | |
| 10 | 302430 | ST | 1 | 1 | 1 | | | female | w-c | 276 | 21 | Creagris | binoculus | | | Bates | 1892 | | 163103223313 | |
| 11 | 302431 | ST | 1 | 1 | 1 | | | female | w-1 | 254 | 24 | Pogonoglossus | horni | | | Sloane | 1907 | | 163103012020 | |
| 12 | 300501 | ST | 1 | 1 | 1 | | | ? | Leica | | 25 | Apotomus | hirsutulus | | | Bates | 1892 | | 1404092319 | |
| 13 | 300502 | LT | 1 | 1 | 1 | | | ? | Leica | | 25 | Apotomus | latigena | | | Reitter | 1892 | | 1404092312 | |
| 14 | 300503 | LT | 1 | 1 | 1 | | | ? | Leica | | 25 | Apotomus | adustipennis | | | Reitter | 1892 | | 1404092310 | 172407154718 |

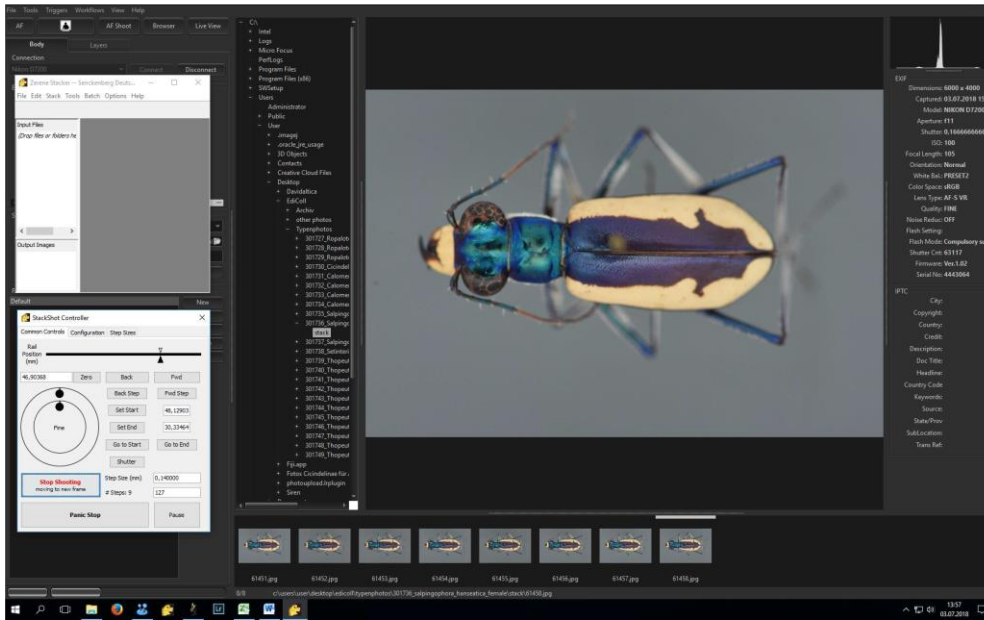
**Photos!**

## Type pictures

- Leica System (<1 cm)
- Workstation Nikon (>1cm)
- Labels are scanned
- Photos and labels – SNG Drive







## Type pictures

- Leica System (<2 mm)
- Workstation Nikon (>2mm)
- Labels are scanned
- Photos and labels – SNG Drive

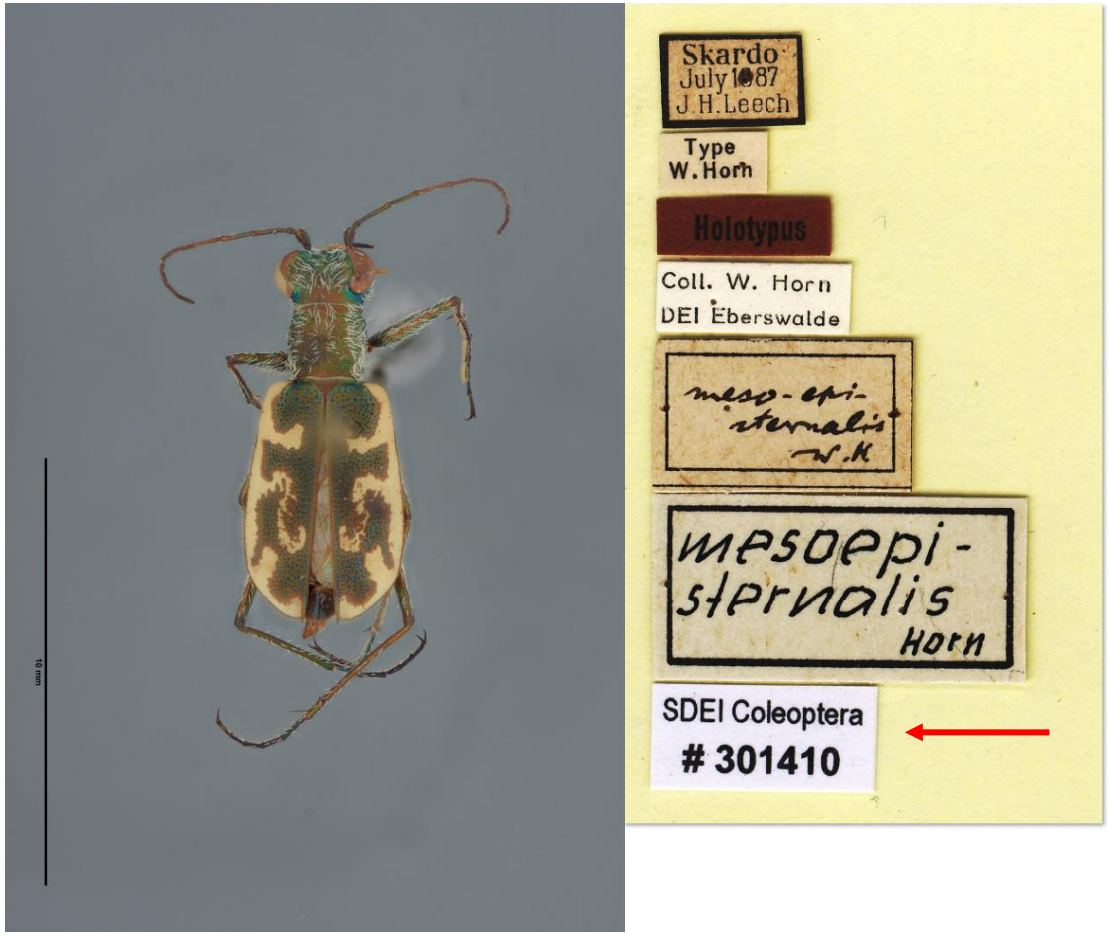
**Quality!**

Stacking

Rename photos

Add scalebar

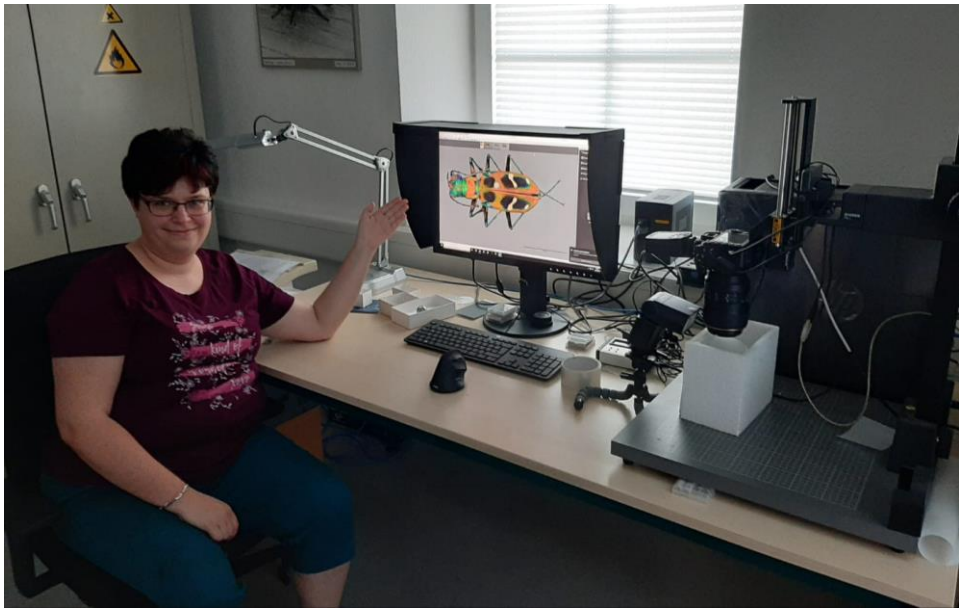
Clean specimens…




**301410**_Cylindera_mesoepisternalis_male_dorsal_2-stacked-final

# Not easy. Not cheap

1. Identification & Taxonomic update
2. Unit tray organzation
3. Photogtaph types (quality pictures)
4. Photograph labels
5. Transcription of the label
6. Clean specimen
7. Transfer specimens from boxes….




**SDEI:** 250,000 Euros

260,000 spec.

~3,000 types

1 person ~7 boxes/week + label - spec.

1 person ~50 spec./week - photos

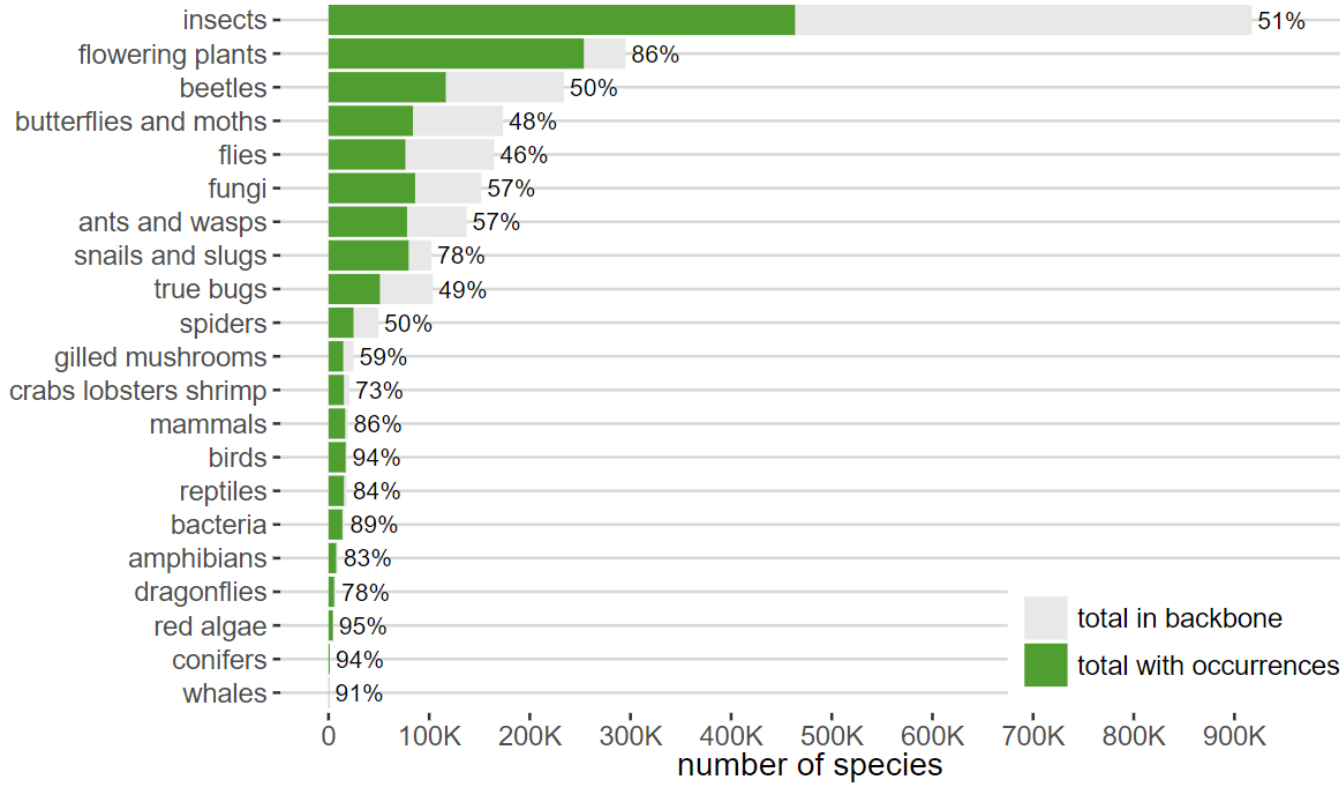
**1+1/2 technitians***

+2 years

# OUTPUT…

- **Global Biodiversity Information Facility (GBIF)**

- **USNM** >34 million insect specimens - only 421,698 records in GBIF
- **SDEI** ~3 million insect specimens - 0 records in GBIF




- Misidentification
- Non -specific record
- Species status not updated
- "Database miscrossing"

# SENCKENBERG

**Taxonomic Revision of the genus *Mesomphalia* Hope, 1839 (Insecta, Coleoptera, Chrysomelidae)**

MARIANNA V. P. SIMÕES[1,3] & MARCELA L. MONNÉ [2,3]

[1]*Division of Entomology, Biodiversity Research Institute & Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, Kansas 66045, U. S. A. E-mail: mariannavpsimoes@gmail.com*

[2]*Museu Nacional, Universidade Federal do Rio de Janeiro. Quinta da Boa Vista, São Cristóvão, 20940-040, Rio de Janeiro, Brazil.*

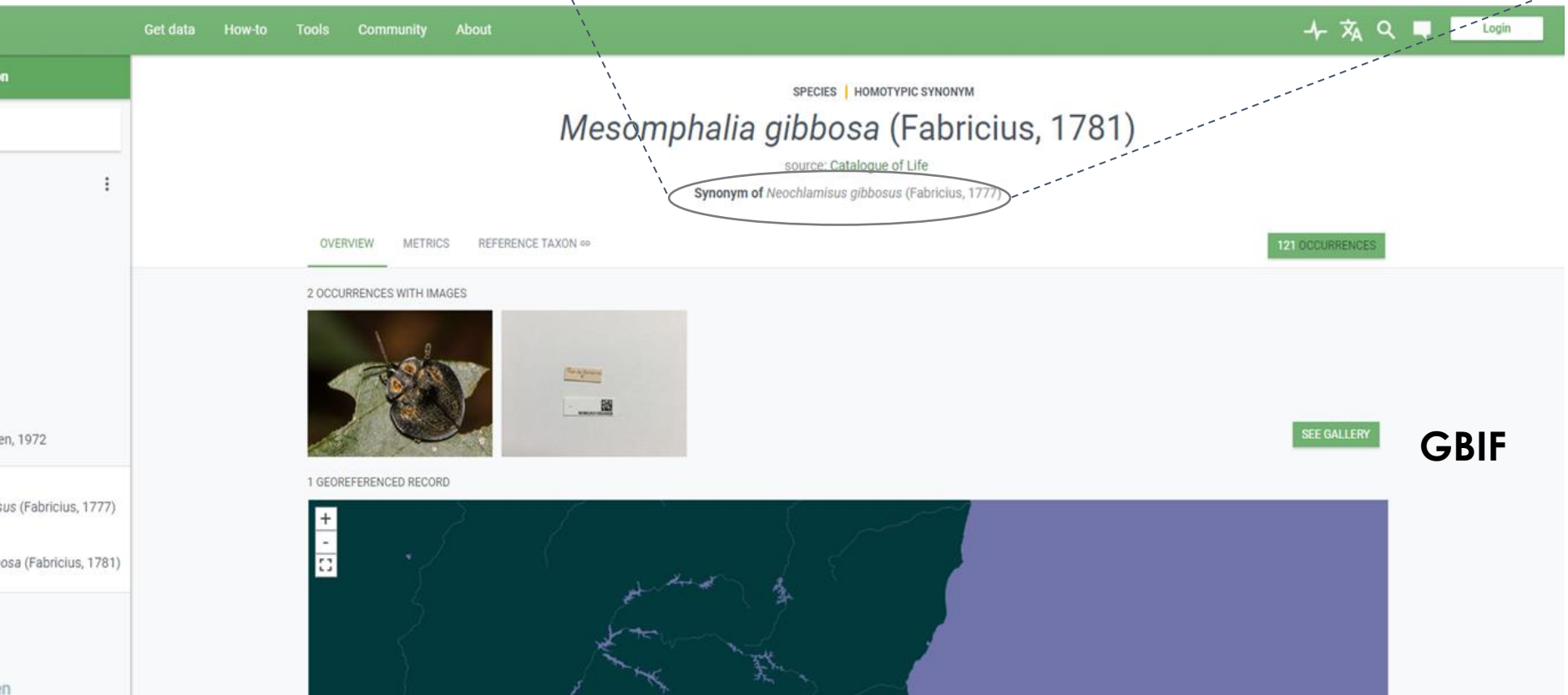
[3]*Fellow of the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)*

***Mesomphalia gibbosa* (Fabricius, 1781)**
(Figs. 1–54, 91–97, 156, 158)

*Cassida gibbosa* Fabricius, 1781: 112; 1787: 65; 1792: 302; 1801: 403; Gmelin, 1790: 1638; Olivier, 1790: 388; 1808: 928; Herbst, 1799: 346; Schönherr, 1817: 225.

*Mesomphalia gibbosa:* Hope,1839: 94; 1840: 91; Boheman, 1850: 223; 1856: 38; 1862: 102; Gemminger & Harold, 1876: 3632; Wagener, 1881: 63; Spaeth, 1901: 339; 1914: 33; Blackwelder, 1946: 737; Borowiec, 1996: 192; 1999: 117; Simões & Monné, 2008: 713; Flinte *et al.*, 2008: 200; 2009: 589; Borowiec & Takizawa, 2011: 448.

*Stolas gibbosa:* Haitlinger, 1991: 397.




**GBIF**

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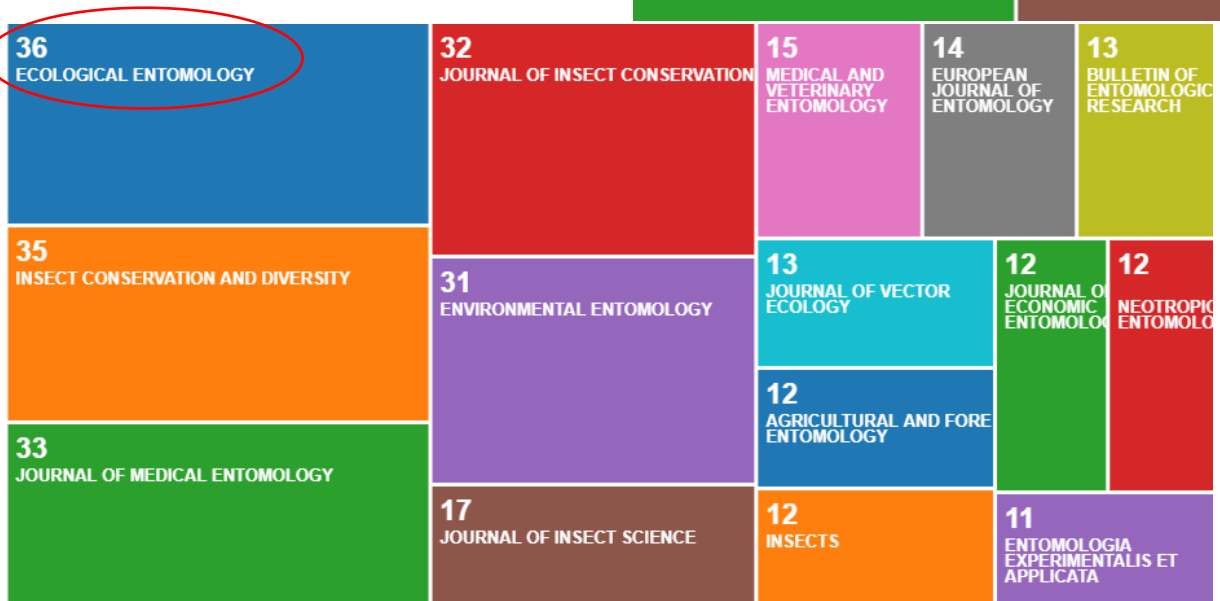
## **Web of Science** (08/06/2020)

Entomology* -

bioclim **OR** Species distribution modeling **OR** Ecological niche modeling **OR** macroecology **OR** spatial ecology

**2000-2010** = **225**


**2010-2020** = **487**



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## **Web of Science** (08/06/2020)

Evolutionary Biology* -

bioclim **OR** Species distribution modeling **OR** Ecological niche modeling **OR** macroecology **OR** spatial ecology

**2000-2010** = **521**


**2010-2020** = **1,707**

The New York Times Magazine

Account

FEATURE

# The Insect Apocalypse Is Here

What does it mean for the rest of life on Earth?

## Climate change on track to cause major insect wipeout, scientists warn

The Guardian

## Nature crisis: 'Insect apocalypse' more complicated than thought

BBC

Environment


# Here's how we know that the UK's insects are dying out

Cry of cicadas

The Economist

## The insect apocalypse is not here but there are reasons for concern

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+Workforce!

# What we need...

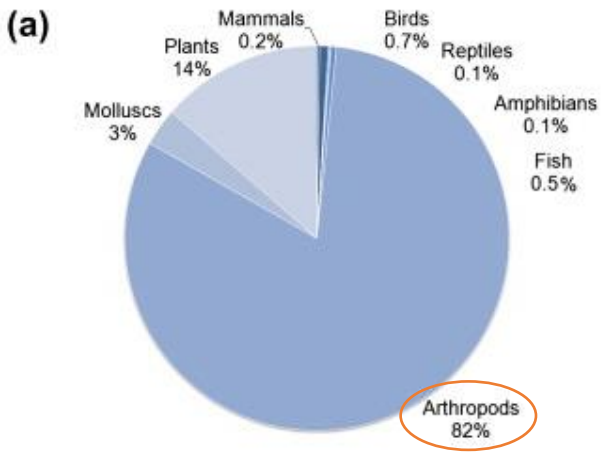
+Investment
+ New tools
+ Database
+ Space

AM_ENT

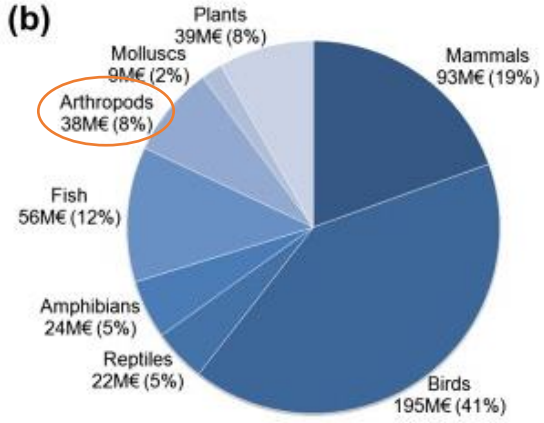
AMNH_PBI 00388325

Unique identifiers

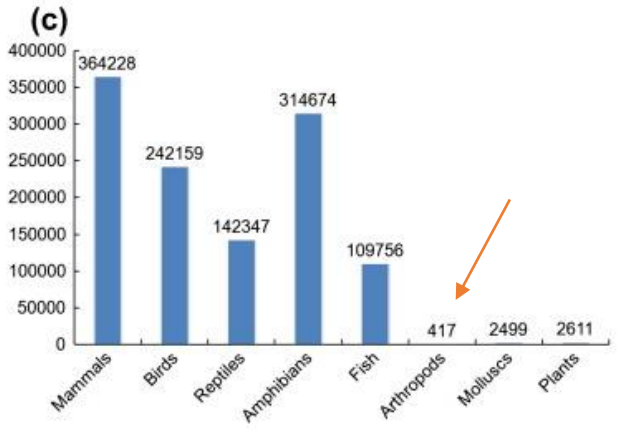

GigaPan




**Diversity**




**Total Investiment per taxon**




**Average funding per species**

**Cardoso et al 2011**. *Biological Conservation.*

# What we need..

+Investment
+ New tools
+ Database
+ Space

KE EMu®
ELECTRONIC MUSEUM

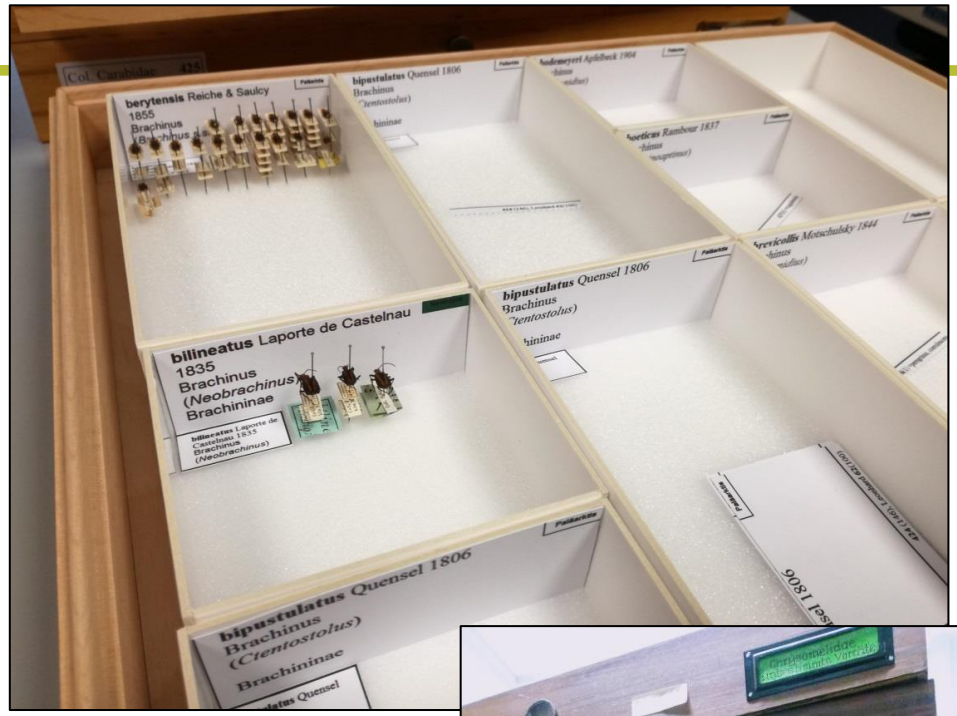
DIVERSITY WORKBENCH

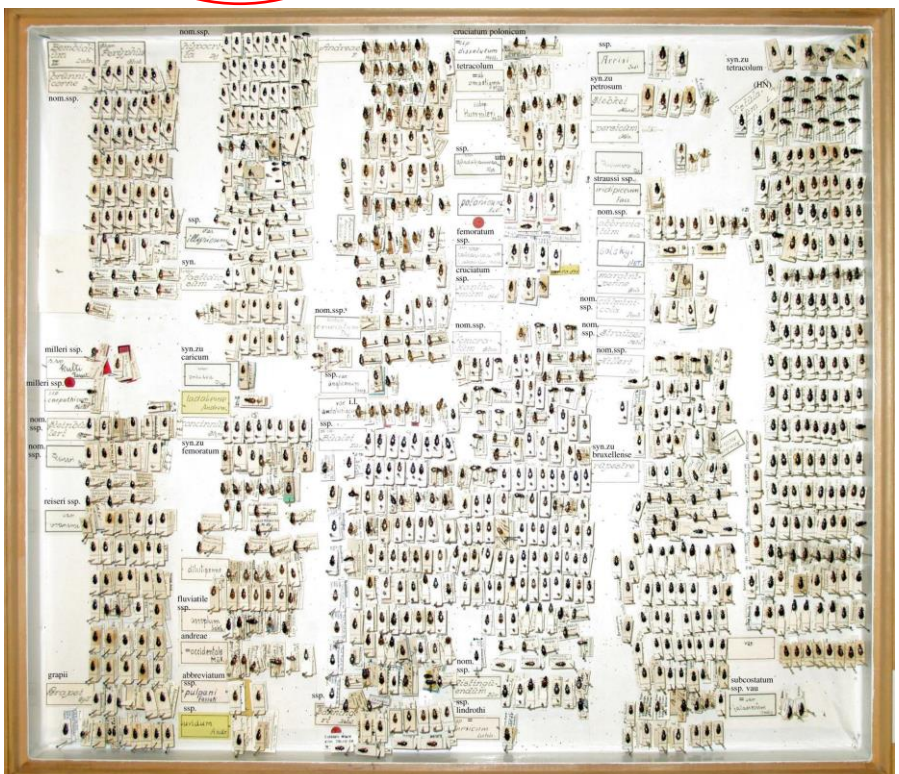
Paradox

Specify

X

+Investment
+ New tools
+ Database
+ Space



1:3…
1:10…
1:20…

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world of biodiversity

# Questions?


Dr. Marianna Simões
Researcher & Curator Coleoptera
Senckenberg Deutsches Entomologisches Institut (SDEI)

marianna.simoes@senckenberg.de @beetler785 msimoes123



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