



LE BARCODING

Codes-barres ADN

Un nouveau regard sur la diversité des lépidoptères

Vers une approche intégrative et pluri-disciplinaire

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University of Guelph, Canada
Directeur: Prof. Paul D. N. Hebert





Making Every Species Count



Building a Bioliterate World

What would it be like to live in a bioliterate world - a world where you could know, in minutes, the name of any animal or plant - any time, anywhere? And not just its name but everything about it - what are its habits, is it endangered, is it dangerous, should it even be there or is it an invader from somewhere else?

How could we use that knowledge to protect our planet's biodiversity and promote human health and well-being?

The International Barcode of Life project (iBOL), the largest biodiversity genomics initiative ever undertaken, is unlocking the door to that world by creating a digital identification system for life.



Wales to barcode all its flowering plants



Researchers with the Barcode Wales project want Wales to be the first country to barcode every one of its native flowering plants.

• Breaking News for Wednesday, May 25, 2011 •

GBIF welcomes iBOL as new Participant



iBOL has signed a Memorandum of Understanding making it an Associate Participant of the Global Biodiversity Information

Registration opens for Adelaide 2011 conference



Registration is now open for the Fourth International Barcode of Life Conference to be held in Adelaide, November 28-December

Spotlight on China in the Barcode Bulletin



Read iBOL's quarterly newsletter for a special report on the growth of DNA barcoding in China and a preview of the big meeting in

Kingdoms of life being barcoded Specimen

Records : **1,680,124**

Specimens with Barcodes : **1,250,791**

Species with Barcodes : **103,456**

Animals:

[Acanthocephala \[188\]](#)

[Annelida \[19345\]](#)

[Arthropoda \[1 230 904\]](#)

[Brachiopoda \[125\]](#)

[Bryozoa \[652\]](#)

[Chaetognatha \[168\]](#)

[Chordata \[239796\]](#)

[Cnidaria \[2835\]](#)

[Cyclophora \[294\]](#)

[Echinodermata \[19588\]](#)

[Echiura \[24\]](#)

[Gnathostomulida \[8\]](#)

[Hemichordata \[15\]](#)

[Mollusca \[51719\]](#)

[Nematoda \[4631\]](#)

[Onychophora \[209\]](#)

[Platyhelminthes \[5946\]](#)

[Porifera \[1161\]](#)

[Rotifera \[3062\]](#)



[Sipuncula \[68\]](#)

[Tardigrada \[703\]](#)

[Xenoturbellida \[2\]](#)

Fungi:

[Ascomycota \[3173\]](#)

[Basidiomycota \[4916\]](#)

[Chytridiomycota \[1\]](#)

[Myxomycota \[8\]](#)

[Zygomycota \[23\]](#)

Plants:

[Bryophyta \[58\]](#)

[Chlorophyta \[4710\]](#)

[Lycopodiophyta \[82\]](#)

[Magnoliophyta \[44365\]](#)

[Pinophyta \[810\]](#)

[Pteridophyta \[1477\]](#)

[Rhodophyta \[21062\]](#)

Protists:

[Chlorarachniophyta \[65\]](#)

[Ciliophora \[499\]](#)

[Heterokontophyta \[9936\]](#)

[Opalozoa \[1\]](#)

[Pyrrophytophyta \[2145\]](#)





Déterminer une espèce, c'est...

- Reconnaître sur l'habitus un certain nombre de caractères à valeur spécifique
- Rapporter ces caractères à un **type** et mettre un nom (nomenclature binomiale)
- Éventuellement décrire (nouvelle espèce)

Tinae
scripta
punctatus
us undulatus
don platyrhinos
Gallus gallus
Turdus migratorius
Oryctolagus cuniculus
Rattus norvegicus
Mus musculus
Homo sapiens
Typhlonectes natans
Ichthyophis bannanicus
Hypogeophis rostratus
Grandisonia alternans
Discoglossus pictus
Xenopus laevis
Scaphiopus holbrookii
Xenopus carolinensis
comantis thomasi
Bufo vallensis
Hyla

Concrètement

- Se référer à la description originale
- Localiser et retrouver le type
- Comparer le spécimen à cet exemplaire, vérifier tous les caractères diagnostiques.



Banister Falls,
Upper Maranon,
N. Peru, 1,000 ft.
A. E. Lepage.

8

10
Holo-
type

X. 2006.

London. Photo J. Haxaire.

Pachygonia
ribbei
peruviana
TYPE H.T.



~~Daphnis~~ Chimæra
Daphnis Rothschild
Type Jan 1894

Borneo.

Type

Sphingid
genitalia slide
No. 755

Rothschild
Bequest
B.M. 1939-1.

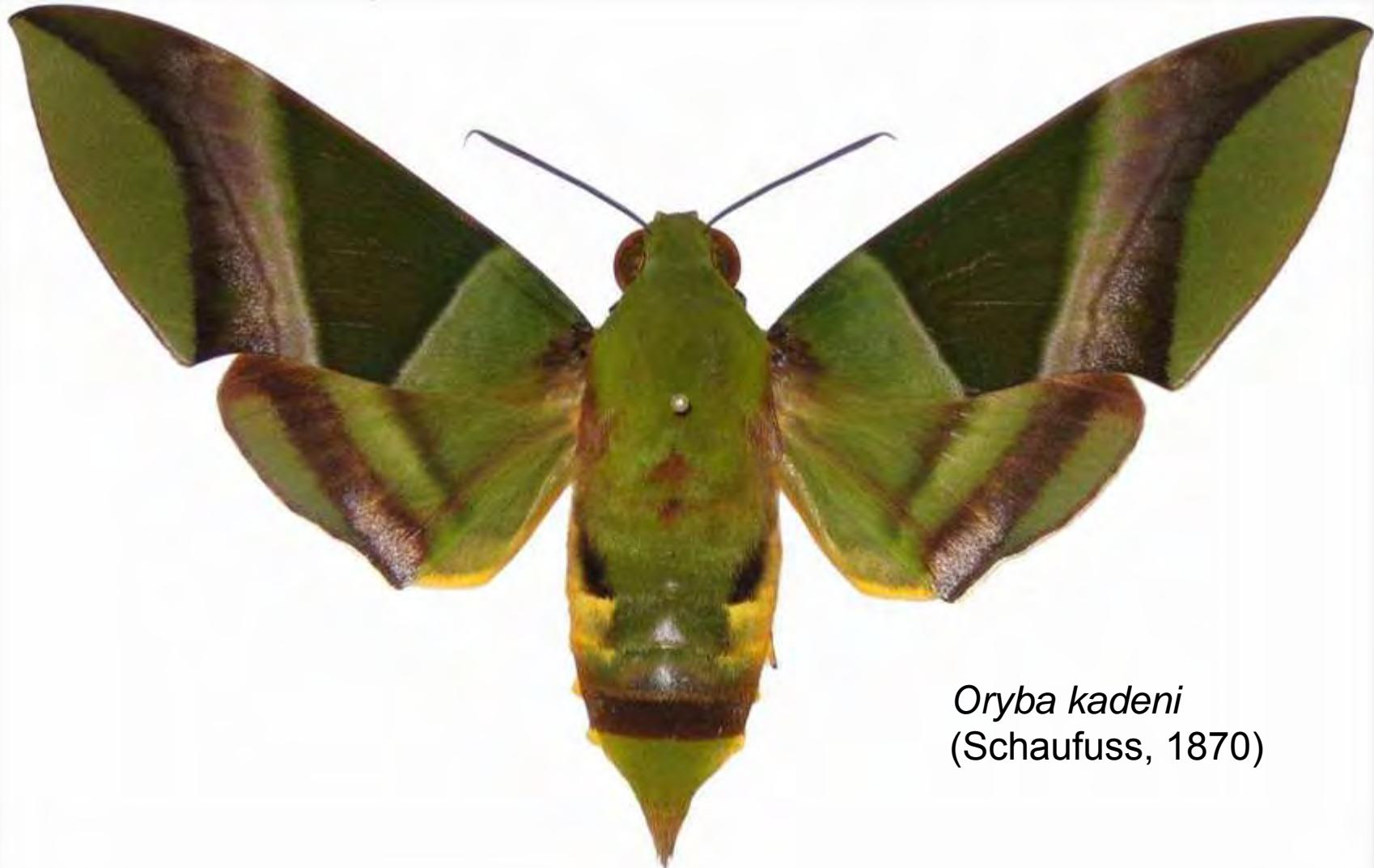
BMNH (E) # 272248

Pourquoi déterminer?

« Un scientifique qui ne s'assure pas de l'identification précise et certaine de l'espèce sur laquelle il travaille accomplit une recherche qui n'est pas scientifique. Ses expériences ne sont pas reproductibles, ses hypothèses ne sont pas testables... »

Loïc Matile, 1987

Pas de problème



Oryba kadeni
(Schaufuss, 1870)

Un peu plus délicat



- Genre *Madoryx*
- espèces homogènes mais identifiables sur l'habitus

Impossible



- Genre *Perigonia*
 - *Détermination impossible sans investigation plus poussée...*

Deuxième niveau d'investigation

- Les genitaliae, ou pièces génitales
- Pour maintenir leur identité, leurs tendance évolutive, les espèces doivent être reproductivement isolées les unes des autres (Hennig, 1960)

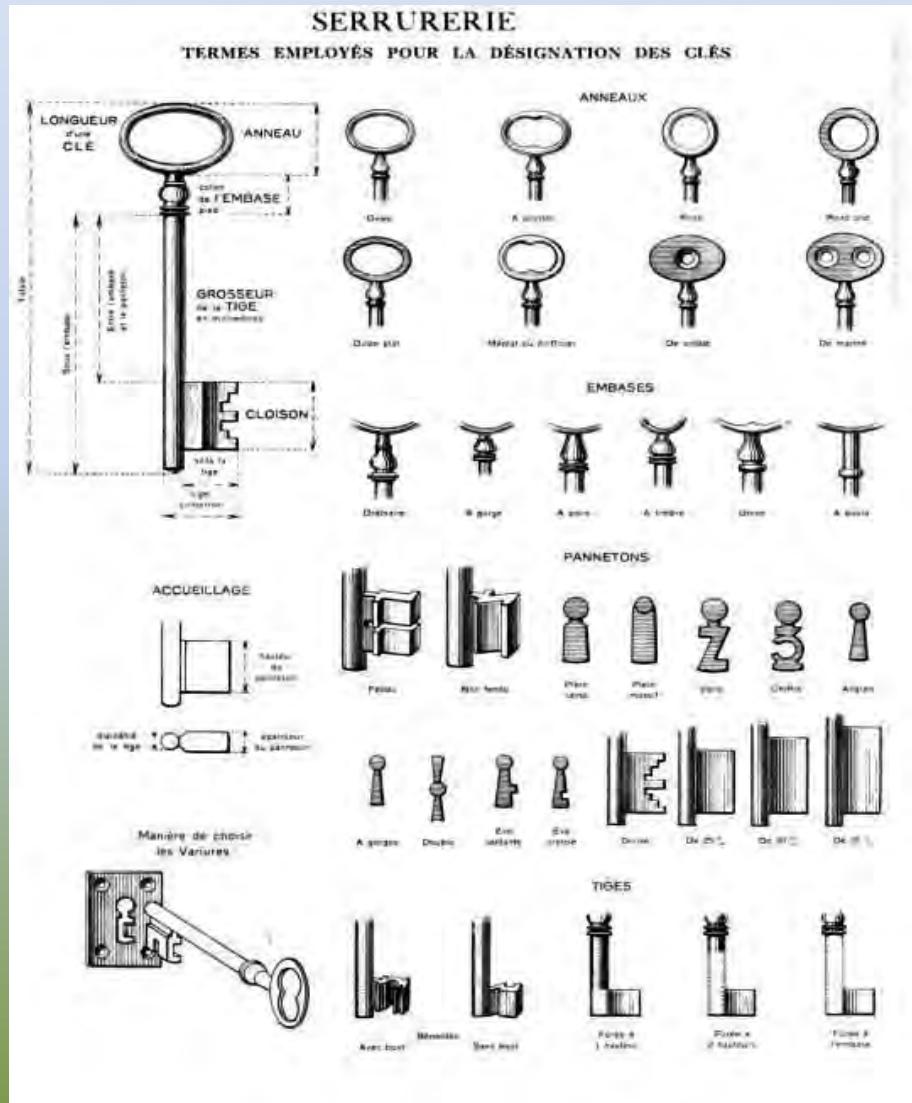


PLATE LIV.

Fig. 1.	Penis-sheath of <i>Xylocopa hypoticta</i>	.	.	.	.	.	.	p. 416
" 2.	" " "	<i>angustia</i>	.	.	.	.	.	p. 418
" 3.	" " "	<i>aztecus</i>	.	.	.	.	.	p. 419
" 4.	" " "	<i>taenia</i>	.	.	.	.	.	p. 418
" 5.	" " "	<i>crucifera</i>	.	.	.	.	.	p. 416
" 6.	" " "	<i>Perigonia grisea</i>	.	.	.	.	.	p. 424
" 7.	" " "	<i>Sesia fadua</i>	.	.	.	.	.	p. 429
" 8.	" " "	<i>titaea</i>	.	.	.	.	.	p. 436
" 9.	" " "	<i>tantalus tantalus</i>	.	.	.	.	.	p. 435
" 10.	" " "	<i>clavigipes</i>	.	.	.	.	.	p. 436
" 11.	" " "	<i>zumata</i>	.	.	.	.	.	p. 435
" 12.	" " "	<i>Eupyrrhoglossum sagittatum</i>	.	.	.	.	.	p. 430
" 13.	" " "	<i>Sciaea ceculata</i>	.	.	.	.	.	p. 433
" 14.	" " "	<i>Amphion venona</i>	.	.	.	.	.	p. 407
" 15.	" " "	<i>Proscopia marofasciata atlantica</i>	.	.	.	.	.	p. 613
" 16.	" " "	<i>Dicroidia inscripta</i>	.	.	.	.	.	p. 604
" 17.	" " "	<i>Darapsa phobus</i>	.	.	.	.	.	p. 525
" 18.	" " "	<i>Ampelocera myron</i>	.	.	.	.	.	p. 523
" 19.	" " "	<i>ceraticolor</i>	.	.	.	.	.	p. 522
" 20.	" " "	<i>Elaphria dolichos</i>	.	.	.	.	.	p. 521
" 21.	" " "	<i>Ampelophaga leucogaster</i>	.	.	.	.	.	p. 519
" 22.	" " "	<i>rufibrunneata</i>	.	.	.	.	.	p. 517
" 23.	" " "	<i>Chrysops ketiale</i>	.	.	.	.	.	p. 505
" 24.	" " "	<i>crotus</i>	.	.	.	.	.	p. 503
" 25.	" " "	<i>Pholus fasciatus</i>	.	.	.	.	.	p. 404
" 26.	" " "	<i>satellitia</i>	.	.	.	.	.	p. 480
" 27.	" " "	<i>labrosa</i>	.	.	.	.	.	p. 495
" 28.	" " "	<i>Tenostoma smaragditis</i>	.	.	.	.	.	p. 498
" 29.	" " "	<i>Dakris rubiginosa</i>	.	.	.	.	.	p. 510



Illustration: le Sphinx du pin



Donc deux espèces confondues
« espèces jumelles »



Sphinx pinastri Linnaeus, 1758



Sphinx maurorum (Jordan 1931)

Troisième niveau d'investigation

Facility: Canadian Centre for DNA Barcoding





DNA Barcoding ?



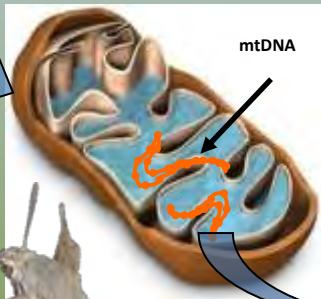
DNA barcoding – Les codes barres ADN

Un code-barres ADN est un court fragment du génome utilisé de manière standard comme marqueur génétique pour l'identification des espèces.

Un système d'identification interne

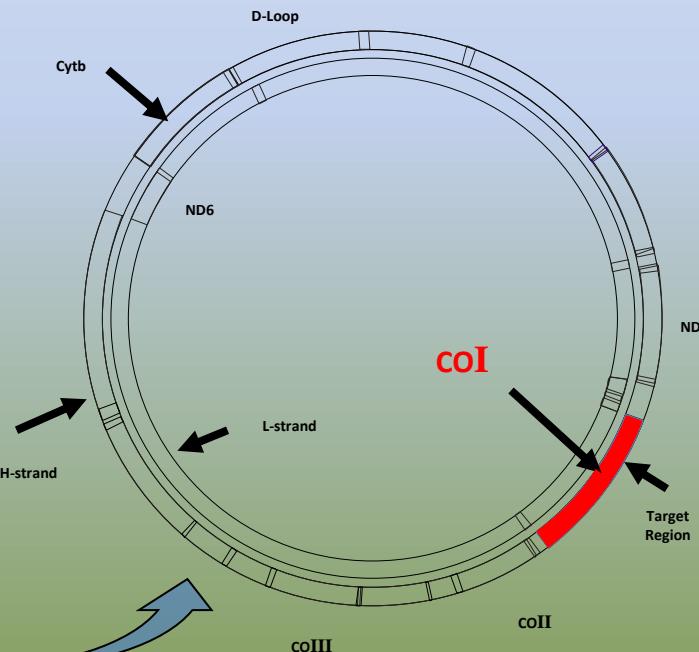


Cellule animale typique

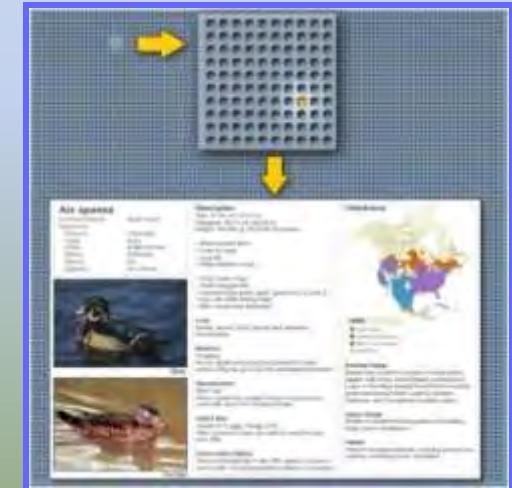


Mitochondrie

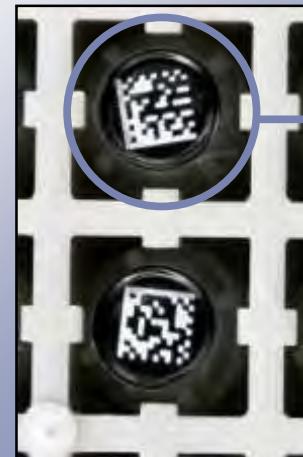
Génome mitochondrial



Développement d'une librairie de référence



Prélèvement sur l'échantillon



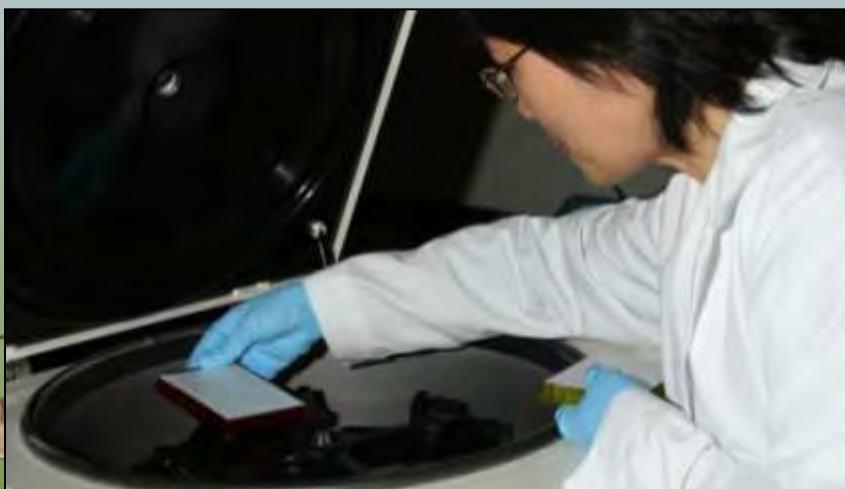


Extraction d'ADN

Méthode manuelle



Méthode automatisée



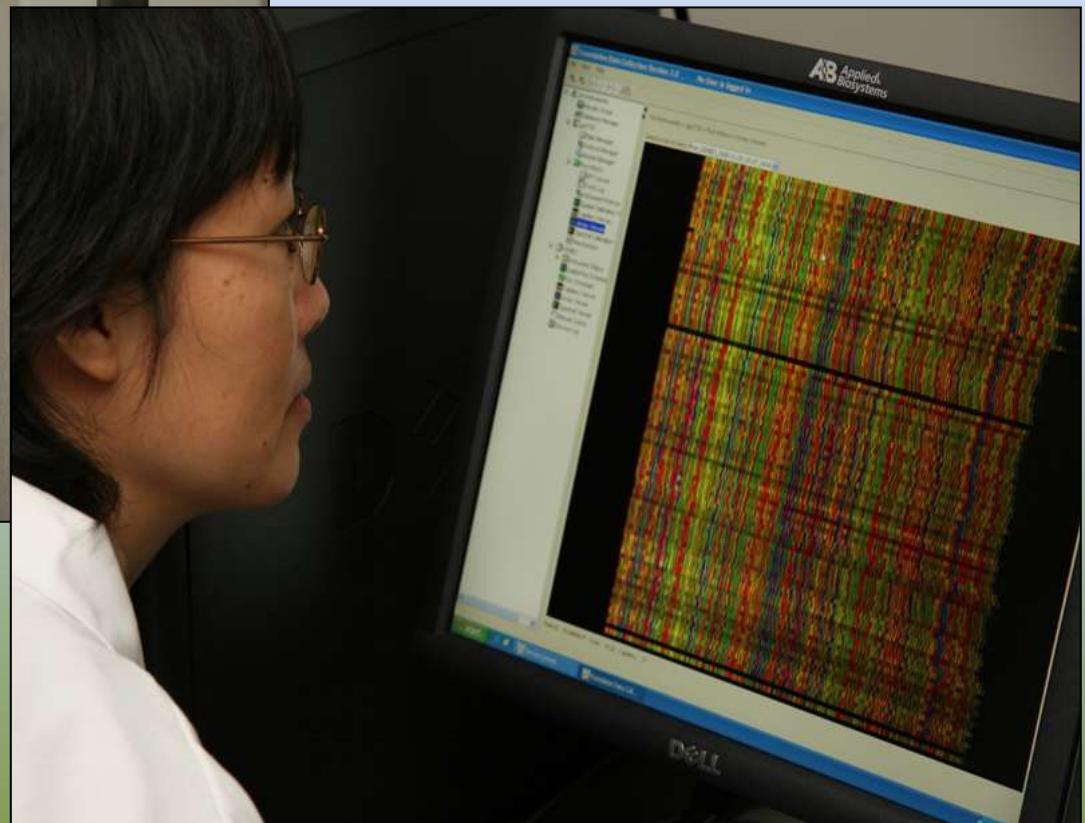
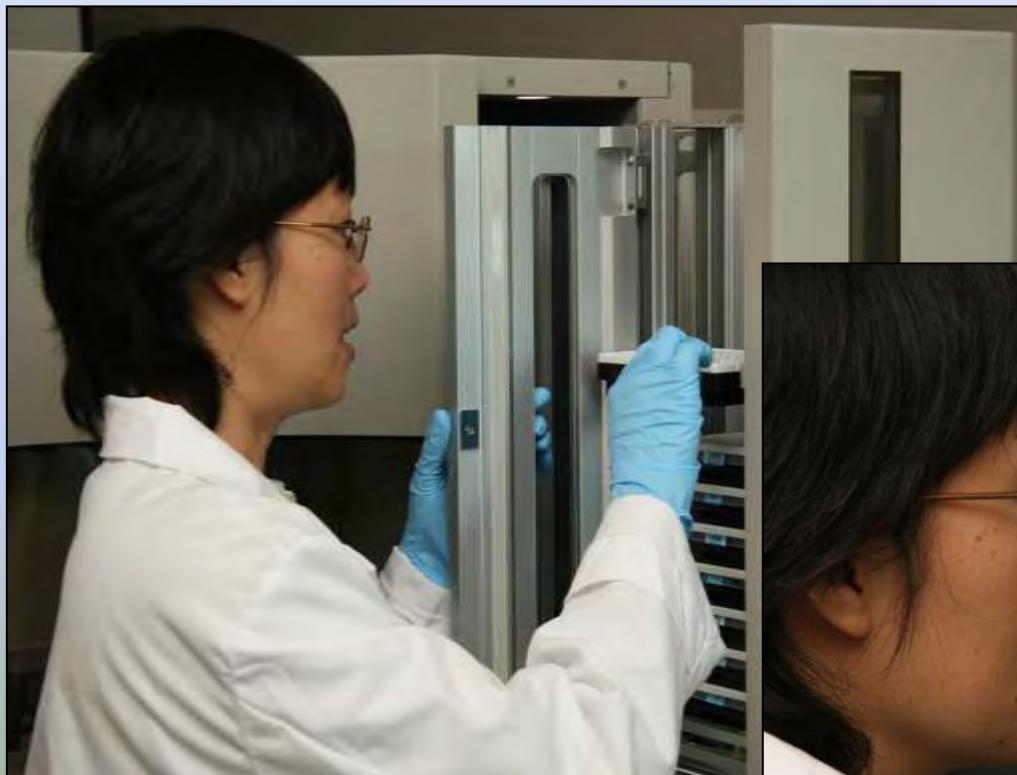
Amplification et séquençage du gène

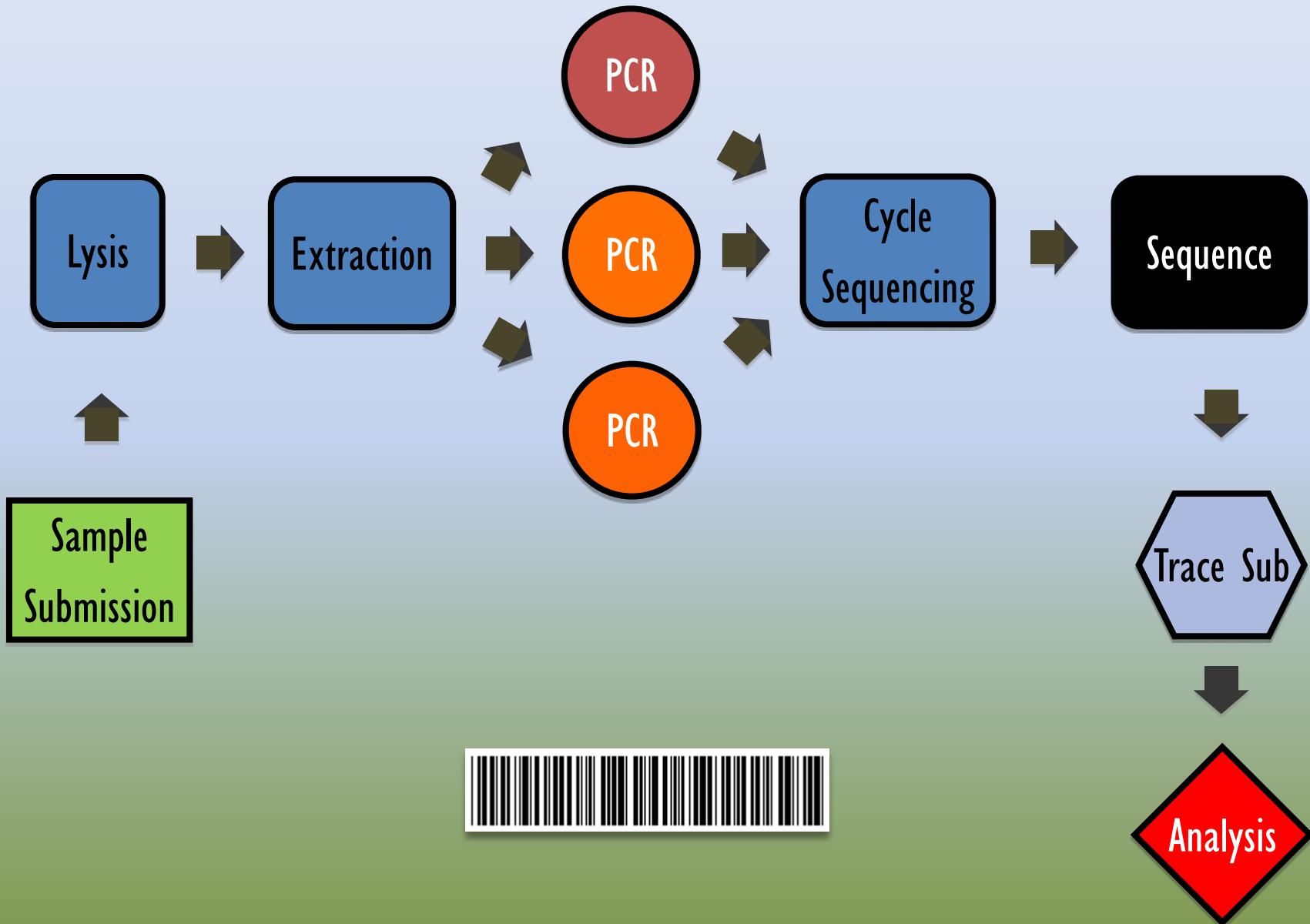


Purification



Séquençage bidirectionnel standard





La campagne ‘Lépidoptères’ – Protocoles au CCDB

	Fresh/Frozen	Time/plate (min)
 Tissue Sampling	\$0.48	60
 DNA Extraction	\$0.64-0.83	30
 PCR Amplification	\$0.49	90
 PCR Product Check	\$0.41	5
 Cycle Sequencing	\$0.82	150
 Sequencing Cleanup	\$1.16	5
 Sequence	\$0.97	90
<u>Total:</u>	\$4.97-5.16	430 min (7.1 h)

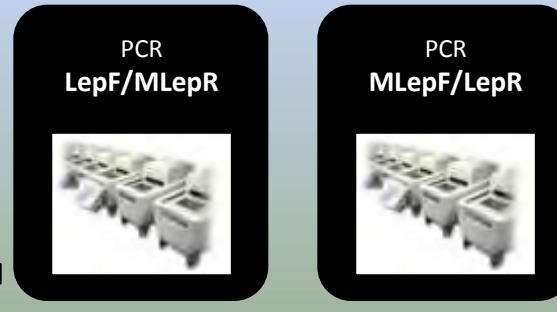


La campagne ‘Lépidoptères’ – Protocoles au CCDB

PCR – Stratégie utilisée en routine

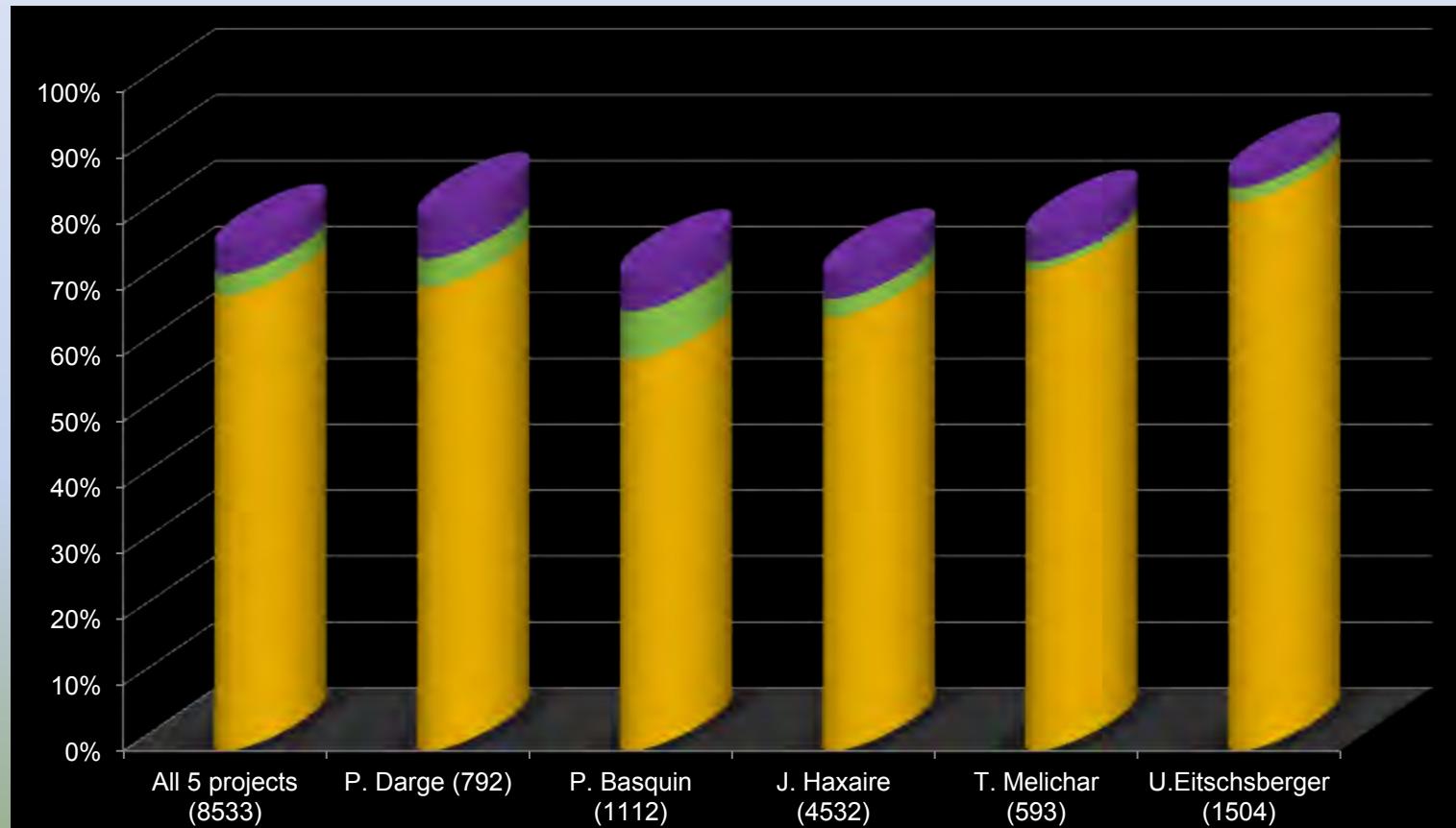


Seconde tentative pour les échecs

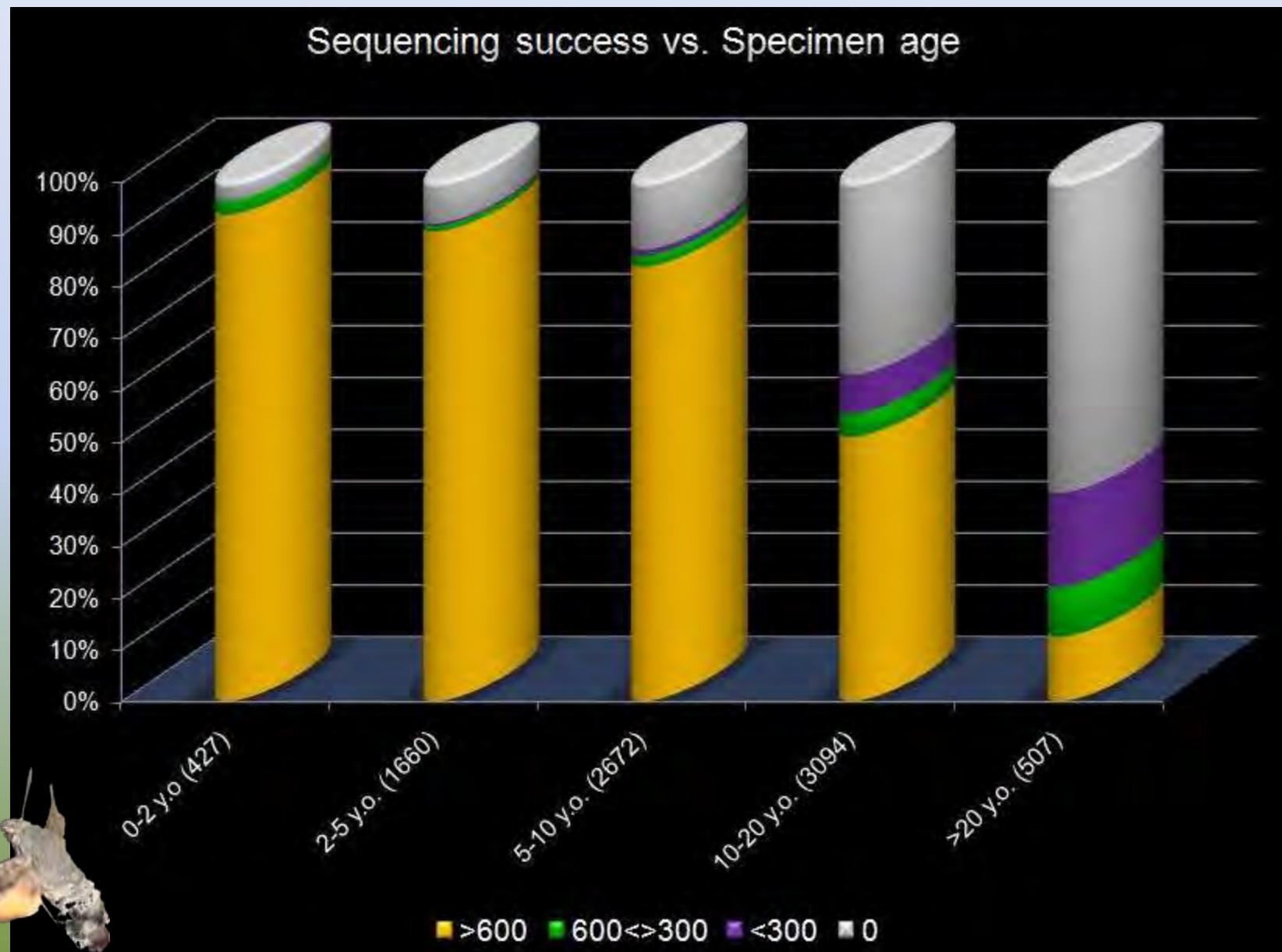


La campagne ‘Lépidoptères’ – Protocoles au CCDB

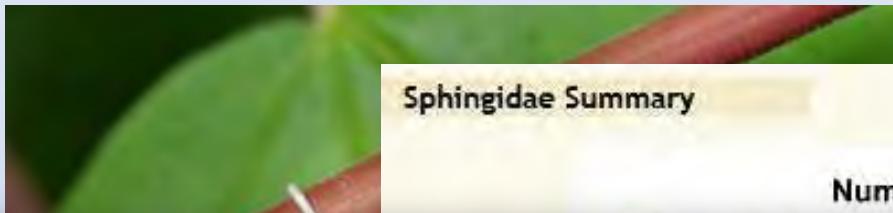
Succès du séquençage (Sphingidae)



La campagne ‘Lépidoptères’ – Protocoles au CCDB



Campagnes globales Sphingidae



Sphingidae Summary

Number of Species: 1288

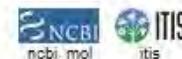
Lineage : Arthropoda; Insecta; Lepidoptera;

Specimen Records : 23,015

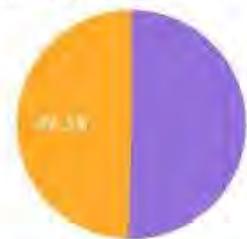
Specimens with Barcodes : 16,976

Public Sequences : 2,174 (Download)

[List of Species Barcoded](#) ([Download](#))

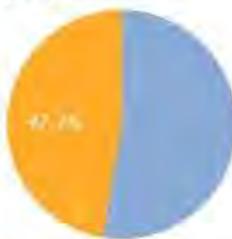


Barcodes :



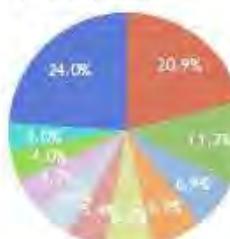
Total Barcodes: 16976
Ref. Barcodes: 8397

Species :



Species Barcoded: 1757
Species with Ref. Barcodes: 830

Deposited in :



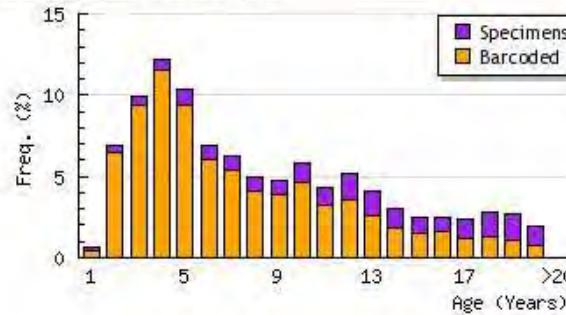
- Research Collection of Jean Haxaire [4802]
- University of Pennsylvania [2685]
- Area de Conservacion Guanacaste [1589]
- Entomologisches Museum Eitschberger Marktleuthen [1583]
- Biodiversity Institute of Ontario [1546]
- Research Collection of Ron Brechlin [1241]
- Research Collection of Tomas Melichar [1131]
- Research Collection of Patrick Basquin [1091]
- Research Collection of D. H. Janzen & W. Hallwachs [923]
- Research Collection of Philippe Darge [910]
- 62. Others [5515]

*Reference barcodes are a validated subset of the full database containing only those species represented by three or more individuals showing less than 2% sequence divergence.



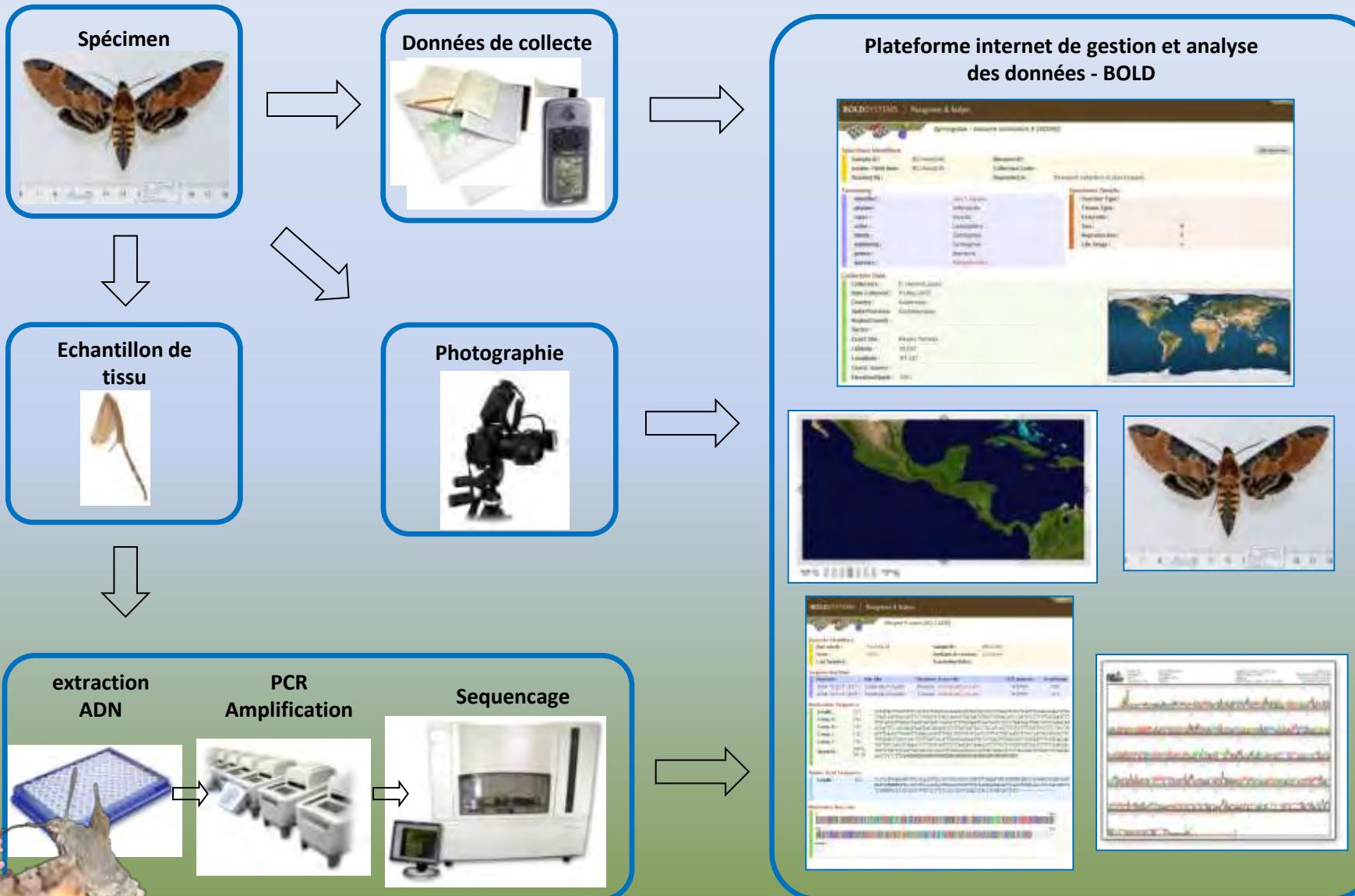
Collected in the following 143 countries :

Specimen Age Distribution



La campagne 'Lépidoptères'

Protocole d'échantillonnage



BOLD – Le portail bioinformatique

Barcode of Life Data Systems					
Advancing species identification and discovery through the analysis of short, standardized gene regions.					
About BOLD | Contact Us					
Published Projects	Taxonomy				
The Barcode of Life Data System analysis, and use of DNA barcode addresses the needs of various groups:					
MANAGEMENT					
BOLD-MAS provides a real-time management system for records coupled with analytical tools as an online workbench for the scientific community.					
IDENTIFICATION					
BOLD-ID5 provides a species identification tool that accepts DNA sequence data from a specific gene region and returns a taxonomic identification at the species level when possible.					
EXTERNAL COLLECTORS					
BOLD-ECS provides web-based tools for bioinformaticians to build the able workflows that can be integrated into their framework. We welcome the addition of analytical modules.					
 					
					
SPTOL Sphingidae - LTOL collection	295	302	199	194	
PMSKN Sphingidae of Kenya and Nigeria	291	293	59	59	
HCKN Sphingidae of Kenya & Virgin Islands	0	3	1	0	
HCPN Sphingidae of Papua New Guinea	143	153	30	29	
SPHOW Sphingidae - Research collection of Jean Haxaire	3010	4435	1109	901	
SOWA Sphingidae - Haxaire collection 1		738	952	263	230
SOWB Sphingidae - Haxaire collection 2		721	983	216	202
SOWC Sphingidae - Haxaire collection 3		585	890	229	190
SOWD Sphingidae - Haxaire collection 4		559	987	336	223
SOWE Sphingidae - Haxaire collection 5		385	601	161	130
SHCHA Sphingidae - Haxaire collection HUB access		22	22	6	6
SPPAN Sphingidae - Research collection of P. Annoyer	48	90	52	33	
SPHPA Sphingidae - Annoyer collection		46	88	50	31
ANNSP Sphingidae - Annoyer collection HUB access		2	2	2	2
SPHPD Sphingidae - Research collection of Philippe Darge	439	596	219	143	
SPPDA Sphingidae - Darge collection 1		439	596	219	143
SPDHA Sphingidae - Darge collection HUB access		0	0	0	0
SPHTV Sphingidae - Research collection of Thierry Vaglia	324	752	245	138	
SPTVA Sphingidae - Vaglia collection 1		324	752	245	138

BOLD – Le portail bioinformatique

BOLD SYSTEMS | Management & Analysis

Earthworms of Normandie (France) [EWNOR]

PROJECT DATA VIEWS

- Specimen Progress**: Sequenced 27%, Remaining 80%
- Species Progress**: Sequenced 20%, Remaining 1%

Primary Marker: COI 5'

Specimen Report

- Specimen recorder: 426
- Lacking gen reference: 0
- Lacking photographs: 0
- Lacking Trace: 24
- Seqs with stop codons: 0
- Contaminated Seqs: 0

Instrumentation

- Data Submission
- Specimen Labels
- Trace Files

Instrument Details

- University of Rouen, ECOHIV Laboratory, France (40)

Users

- Rodolphe Rousset: rrouge@cupomph.ca
- René Richard: renat.richard@etu.univ-rouen.fr
- David Perez: david.perez@free.fr
- Agata Pawłowska: pawla@cupomph.ca
- Thibaud Decaens: thibaud.decaens@univ-rouen.fr

BOLD – Le portail bioinformatique

BOLDSYSTEMS | Management & Analysis

Earthworms of Normandie (France) [EWNOR]

Project Data Select ▾ **Specimens & Sequences** 376 / 436

Identification	Specimen Page	Sequence Page	Residues [Ambig]	Contains	Extra Info	Set	
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0297	EWNOR396-08	656 [0n]				PrPfa
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0187	EWNOR196-08	0				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0188	EWNOR185-08	602 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0185	EWNOR184-08	620 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0188	EWNOR184-08	655 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0164	EWNOR163-08	658 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0163	EWNOR162-08	644 [1n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0152	EWNOR151-08	589 [0n]				PrPfa
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0151	EWNOR150-08	652 [0n]				PrPfa
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0150	EWNOR149-08	655 [0n]				PrPfa
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0137	EWNOR136-08	655 [0n]				PrPfa
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0136	EWNOR135-08	655 [0n]				PrPfa
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0088	EWNOR088-07	658 [0n]				FeCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0243	EWNOR342-08	648 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0342	EWNOR341-08	648 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0341	EWNOR340-08	648 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0331	EWNOR330-08	648 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0230	EWNOR329-08	648 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0229	EWNOR320-08	648 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0218	EWNOR315-08	648 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0215	EWNOR314-08	648 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0214	EWNOR313-08	648 [0n]				PrCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0200	EWNOR299-08	648 [0n]				PrVal
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0287	EWNOR285-08	582 [0n]				PrVal
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0286	EWNOR285-08	199 [0n]				PrVal
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0273	EWNOR272-08	649 [0n]				PrVal
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0272	EWNOR271-08	654 [0n]				PrVal
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0236	EWNOR235-08	655 [0n]				FePfa
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<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0085	EWNOR085-07	658 [0n]				FeCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0084	EWNOR084-07	658 [0n]				FeCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0083	EWNOR083-07	658 [0n]				FeCot
<input type="checkbox"/> <i>Alobophora chlorotica</i>	EW-ECO-0080	EWNOR082-07	658 [0n]				FeCot

Options
List All Projects
Back to Project Console
Move Records to another Project
Summary- Specimens, Localities, and Identifiers

Downloads
Sequences
Data Spreadsheet
Specimen Labels
Trace Files

Sequence Analytics
Taxon ID Tree
Distance Summary
Sequence Composition
Nearest Neighbor Summary
Specimen Age vs Seq Length

Identifications

Distribution Analytics
Distribution Map
Image Library

BOLD – Le portail bioinformatique

BOLDSYSTEMS | Management & Analysis

Earthworms of Normandie

Specimen Identifiers

Sample ID : EW-ECO-0314
Isolate / Field Num: EW-ECO-0314

Donated By :

Taxonomy

Identifier: Béard Richard
phylum: Annelida
class: Clitellata
order: Haplotaxidae
family: Lumbricidae
genus: Allolobophora
species: *Allolobophora crinita*

Collection Data

Collectors : B. Richard
Date Collected : 17-Mar-2008
Country : France
State/Province: Seine Maritime
Region/County: Seine Maritime
Sector:
Exact Site : Herouville, calcaire
Latitude : 49.484
Longitude : 0.931
Coord. Source:
Elevation Depth:

Photographs



BOLDSYSTEMS | Management & Analysis

Earthworms of Normandie (France) [EWIVOR]

Specimen Identifiers

Sample ID: EW-ECO-0314
Isolate / Field Num: EW-ECO-0314
Catalog Number:
Collection Code:
Donated By:
Vouchered at: 622

Photographs



BOLD – Le portail bioinformatique

 Lumbricidae	EW-ECO-0252	EWNOR251-08	657 [0n]	  	FoPla
 Lumbricidae	EW-ECO-0251	EWNOR250-08	658 [0n]	  	FoPla
 Lumbricidae	EW-ECO-0249	EWNOR248-08	658 [0n]	  	FoPla
 Lumbricidae	EW-ECO-0245	EWNOR244-08	658 [0n]	  	FoPla
 Lumbricidae	EW-ECO-0244	EWNOR243-08	649 [0n]	  	FoPla
 Lumbricidae	EW-ECO-0243	EWNOR242-08	658 [0n]	  	FoPla
 Lumbricidae	EW-ECO-0242	EWNOR241-08	658 [0n]	  	FoPla
 Lumbricidae	EW-ECO-0229	EWNOR228-08	658 [0n]	  	FoPla
 Lumbricidae	EW-ECO-0057	EWNOR057-07	658 [0n]	  	PrPla
 Lumbricidae	EW-ECO-0056	EWNORD056-07	0	  	PrPla
 Lumbricidae	EW-ECO-0055	EWNOR055-07	658 [0n]	  	PrPla



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Barcode Identifiers

Barcode ID: EW NOR242-08
Gene: COX1
Last Updated: 2008-05-02

Sequencing Runs

Run Date	Direction	Trace File
2008-04-18 01:14:33	Reverse	EW NOR242-08_R.fsa
2008-04-17 09:27:44	Forward	EW NOR242-08_F.fsa

Nucleotide Sequence

Residues:	Sequence
658	AACCTTATATTCTTCACTTTGGAGTC AAGACAGCCGCGGAGCTTCTTGGC TTCTCTCTTAACTTACGCTATTTC CATAGCTTCCCACGCCCTAAATAAT CCTGTAGAAAAGGACTGGACAC TTCAGTAGCTTGCAATTTCCTCC GACCTTAATTTATACGATGAGAG GTTGTTTACTCTTAACTCTCTAA TACTICATTTTGACCCCGCTGGAA

Amino Acid Sequence

Residues:	Sequence
218	XILYFILQVWAGHVAGKNSILLTRIEESQPHAYLSDQDQI DIAFFPFLRGRIFNLLPPSLILLVSSAAVERGAGIUNTYFPE TIVIIRHPSQSLRERIPLPVAVVITVVLLLSPIPVLAGAA

Illustrative Barcode

Report From LIMS

BOLD LIMS Report Available

BOLDSYSTEMS Management & Analysis

Earthworms of Normandie (France) [EW NOR]

W-ECO-0243 [EW NOR242-08]

Sequencing Run

Date: 2008-04-18 PCR primers: LCO1490_HMCO2198_11
File: EW NOR242-08_R.fsa1 Seq Primer: M13R
Status: high qual Direction: Reverse

Quality Scores

Mean:	51.4914
Var:	68218.5
SdDev:	297.016
SdErr:	11.2422

Sequencing Run

Date: 2008-04-18 File: EW NOR242-08_R.fsa1 Status: high qual

Specimen Identification Request

Search Request:
Type: ECOPLA DATABASE

Search Result:
A species level match could not be made, the queried specimen is likely to be one of the following:

- Apertochela caliginea
- Lumbricidae
- Apertochela sp.
- Ornithodoros sp.
- Apertochela paucisetosa
- Apertochela transversa

Distance Summary

Distance scores of the top 100 matches

TOP 20 Matches

Phylum	Class	Order	Family	Genus	Species	Specimen Similarity (%)
annelida	Clitellata	Reptilia	Lumbricidae	Apertochela	caliginea	100
annelida	Clitellata	Reptilia	Lumbricidae	Apertochela	caliginea	100
annelida	Clitellata	Reptilia	Lumbricidae	Apertochela	caliginea	100
annelida	Clitellata	Reptilia	Lumbricidae	Apertochela	caliginea	100

BOLD – Le portail bioinformatique

The screenshot displays the BOLD Systems Management & Analysis interface. The top navigation bar includes the BOLD SYSTEMS logo, a search bar, and links for Management & Analysis, Earthworms of Normandie (France) [EWNOR], and Options. On the left, a sidebar contains sections for Options (List All Projects, Back to Project Console, Move Records to another Project), Data Management (Sequences, Data Spreadsheet, Specimen Labels, Trace Files), Sequence Analysis (Taxon ID Tree, Distance Summary, Sequence Composition, Nearest Neighbor Summary, Specimen Age vs Seq Length), and Distribution (Distribution Map, Image Library). The main workspace shows a sequence tree with five numbered panels (1-5) highlighting specific regions. Below the tree is a list of sequence entries, an 'Apply Filters' section, and a 'Colorize Tree Based on' dropdown. A decorative illustration of a bird is visible in the bottom left corner.

Campagnes globales Sphingidae

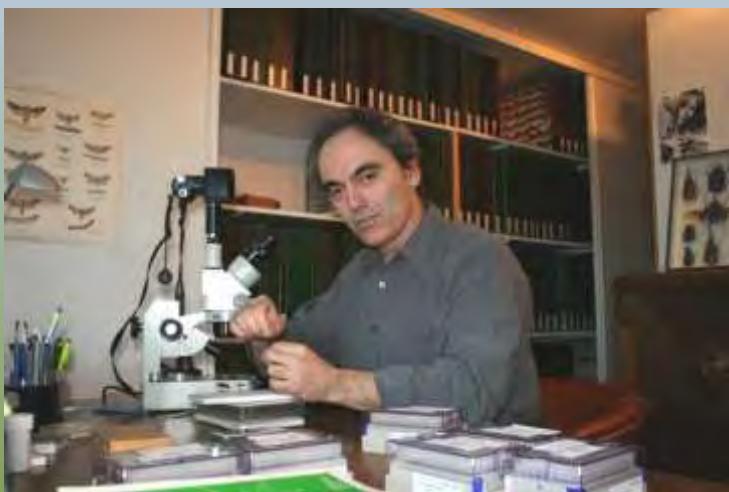


**Diversité globale affectée
par:**

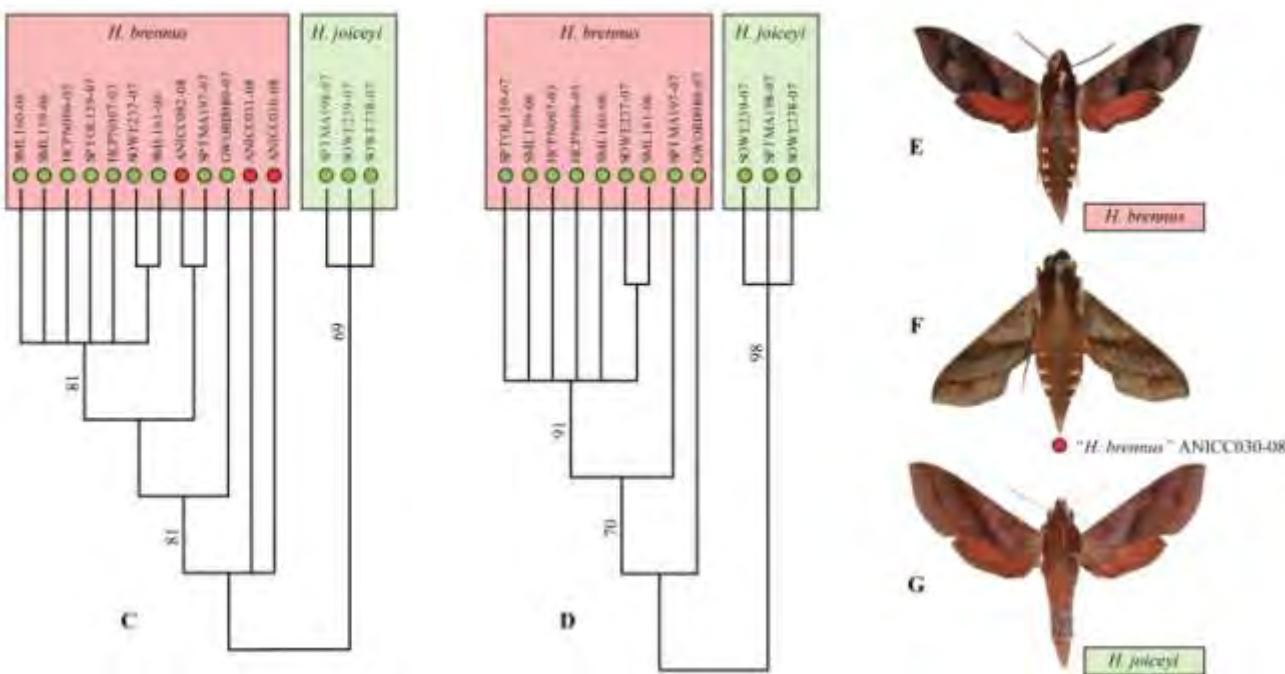
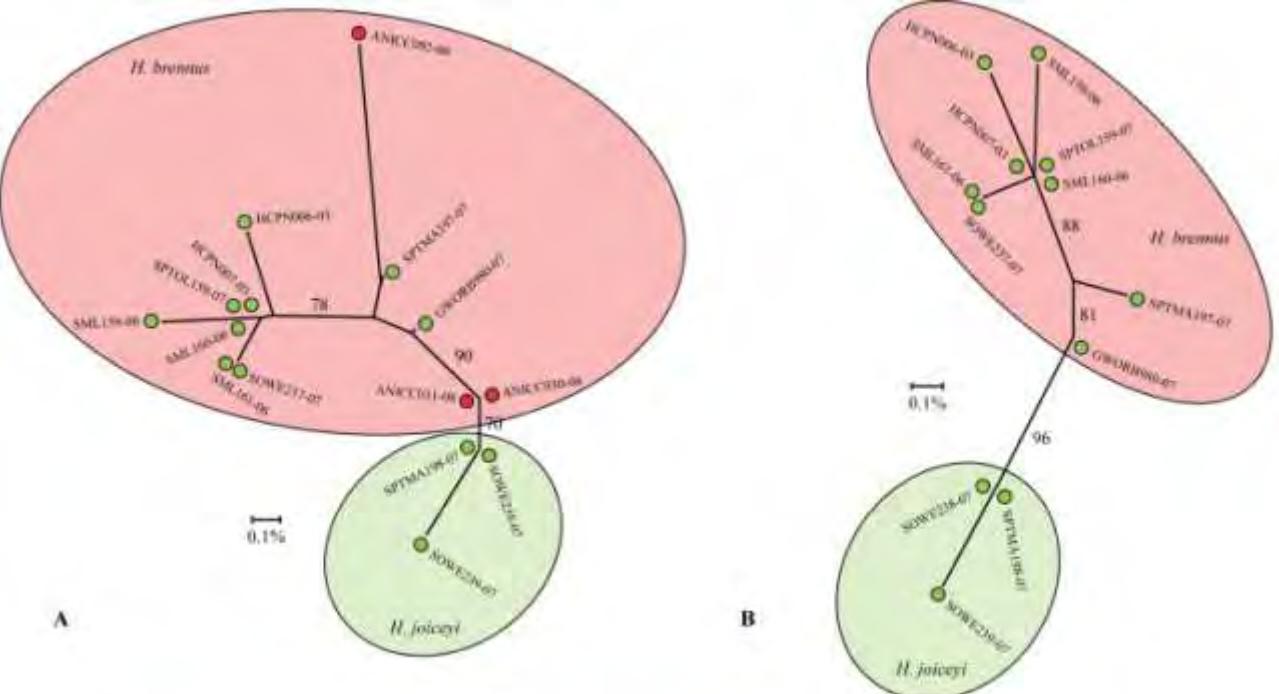
- (+) Diversité cryptique
- (+) re-validation de synonymes
- (-) Synonymies

Campagnes globales: Saturniidae et Sphingidae

Origine des spécimens et de l'expertise taxonomique



visualisation



Les *Xylophanes*
du groupe *neoptolemus*

2ème exemple espèces proches, voir jumelles...

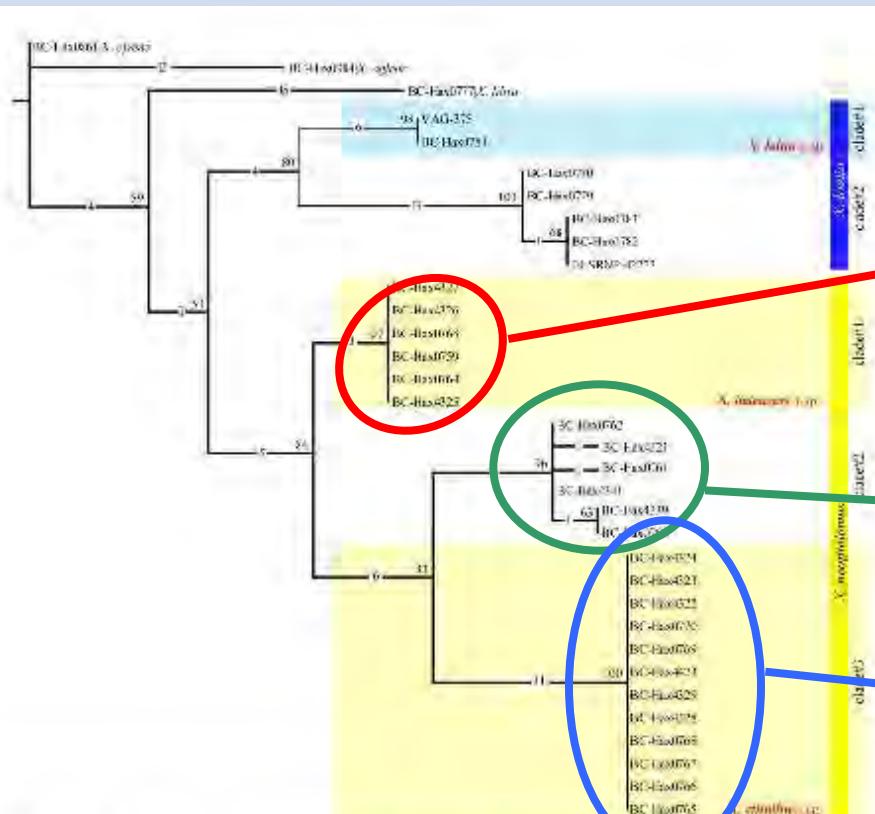
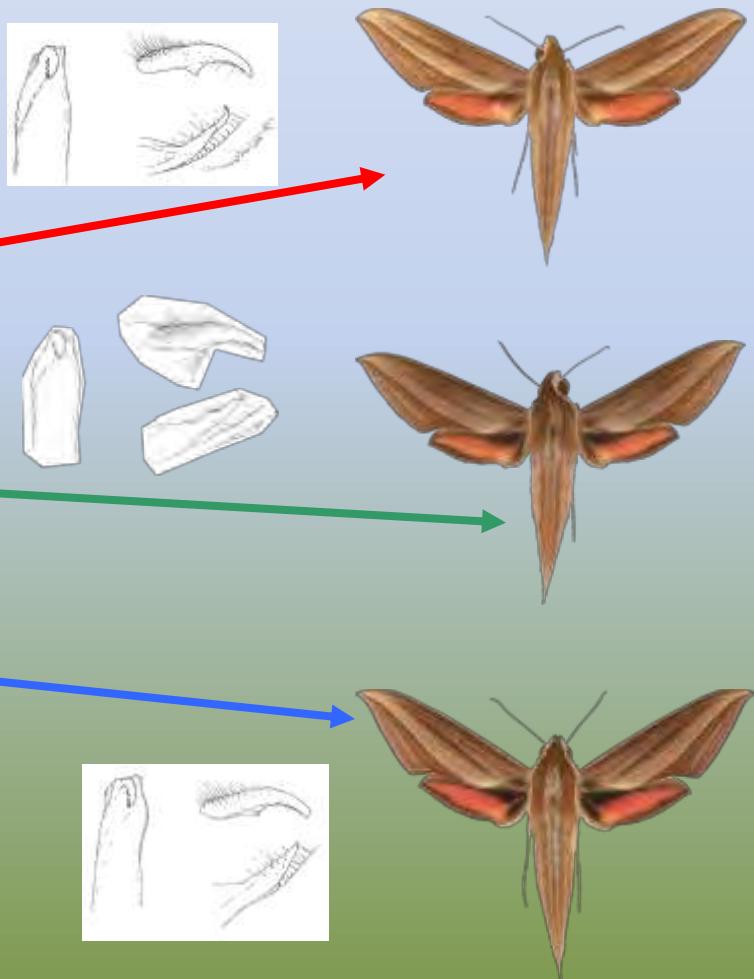


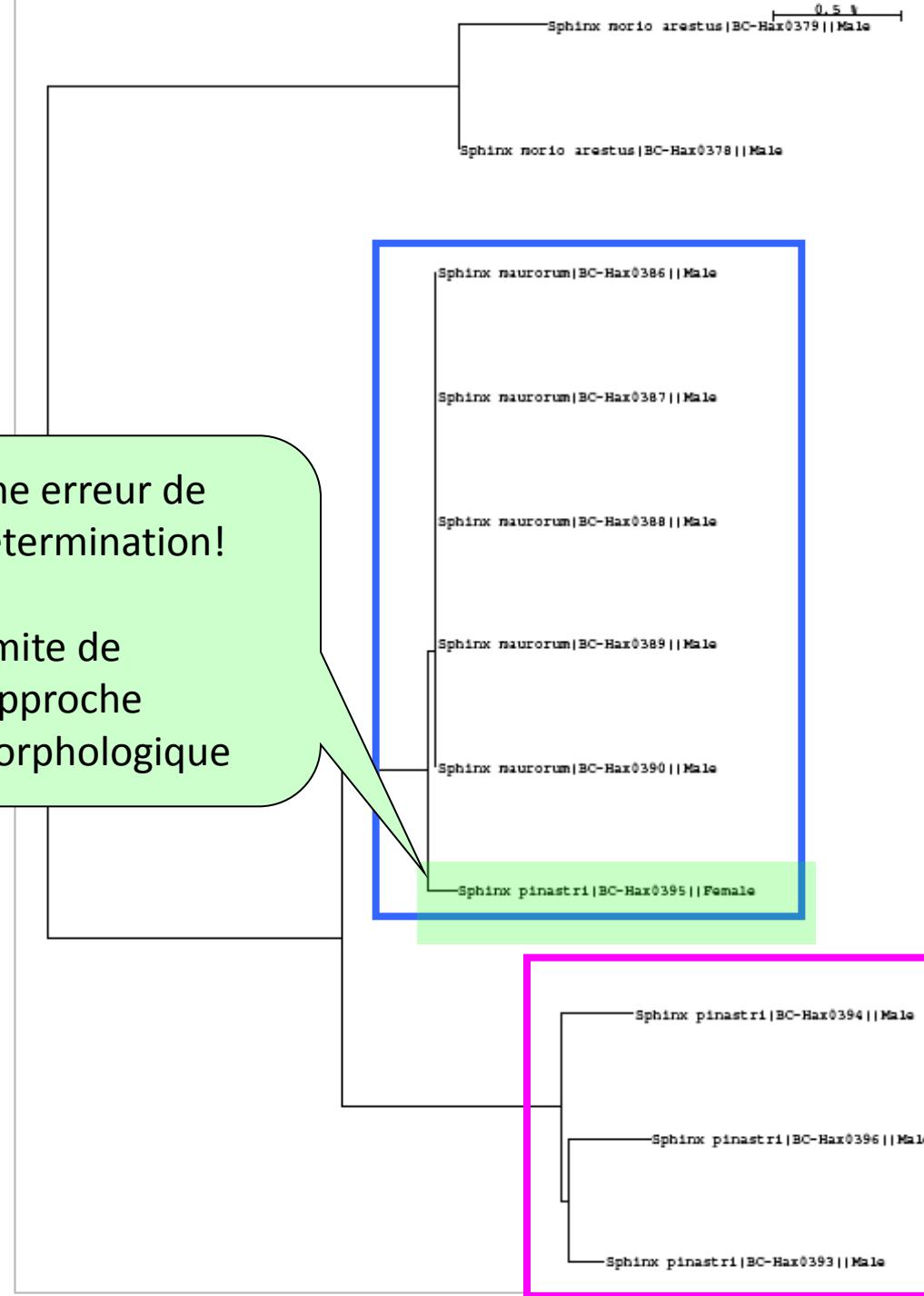
Fig. 34. Single most parsimonious tree ($L=132$, $CI=0.78$, $RI=0.93$) obtained after analysis of the 34 full-length barcodes, each terminal being identified by its sampleID code (see table 1). The number of inferred unambiguous substitutions is indicated on each branch, and the bootstrap support is given at each node.



Dans l'exemple du Sphinx du pin

Une erreur de
détermination!

Limite de
l'approche
morphologique



Cause de l'erreur



Même espèce: *Sphinx maurorum*

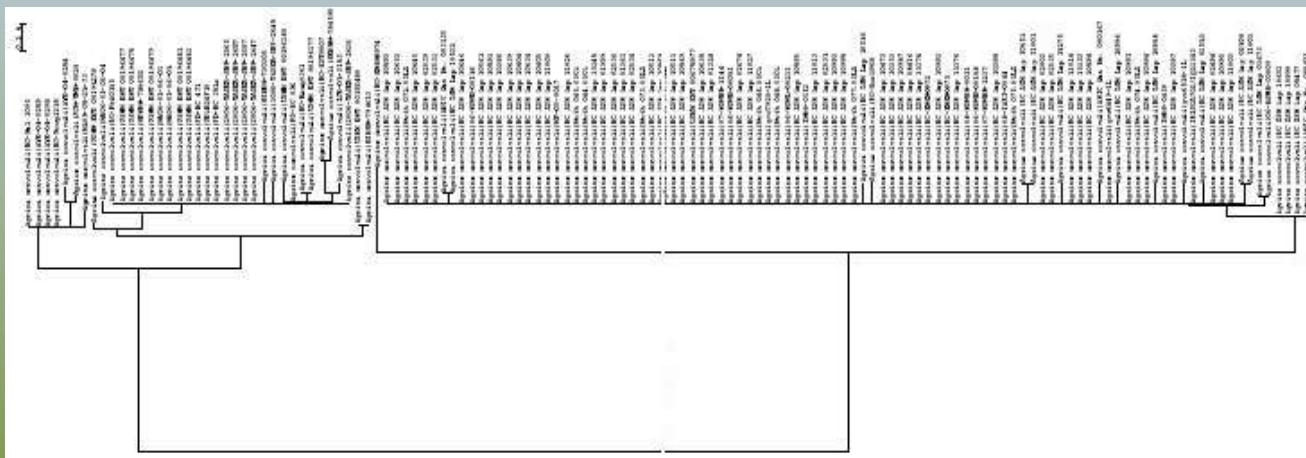
Les différences d'habitus de la larve ne tiennent pas

Les codes-barres ADN – au-delà de la taxonomie

- Réévaluation de l'endémisme des sphinx australiens

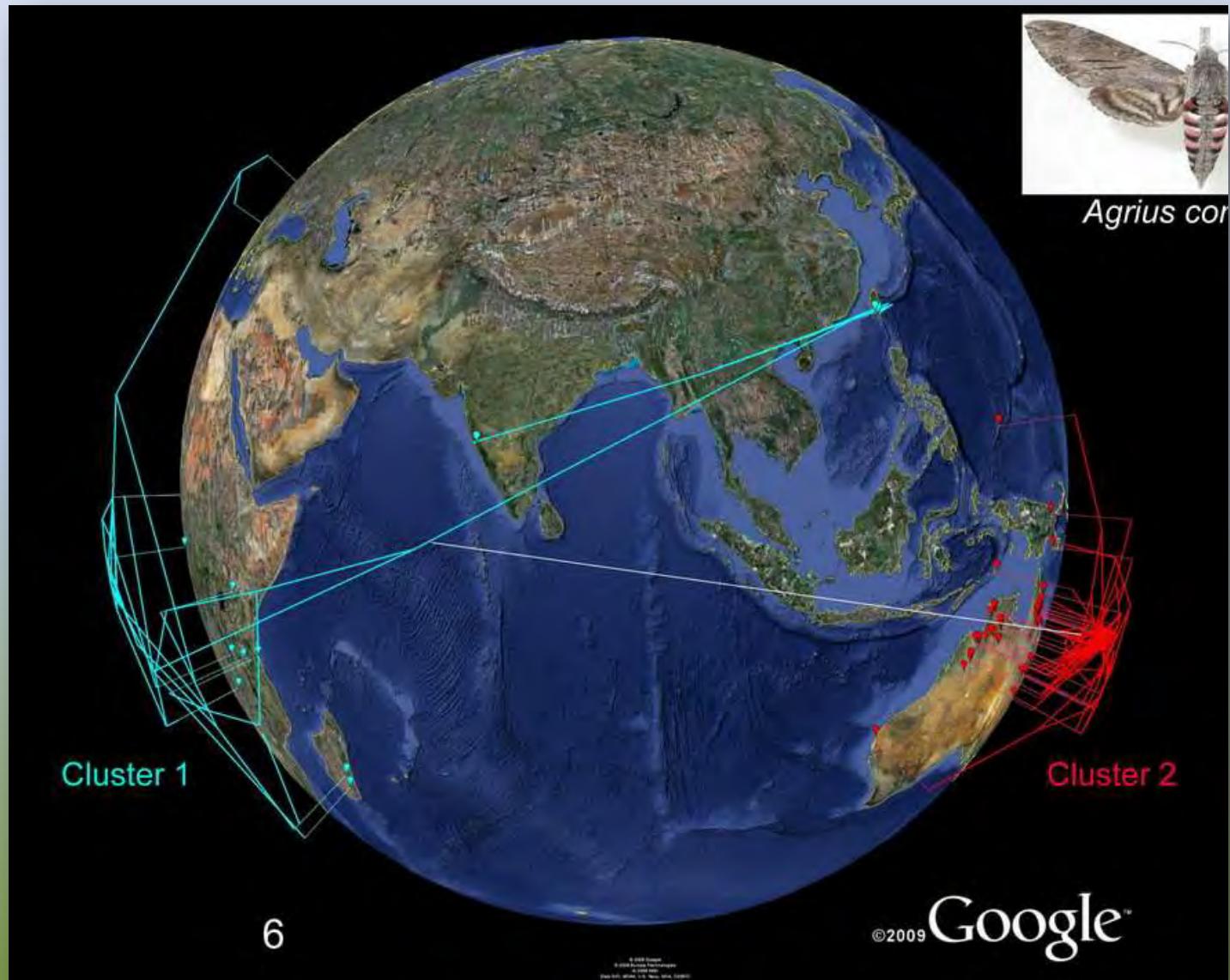


Agrius convoluli



Les codes-barres ADN – au-delà de la taxonomie

- Réévaluation de l'endémisme des sphinx australiens



Integration de spécimens types

Hajibabaei, M., A. Smith, et al. (2006). "A minimalist barcode can identify a specimen whose DNA is degraded." Molecular Ecology Notes: 959-964.



Fragment court d'environ 120 bp



Sphinx lugens Walker, 1856

>150 y.o.



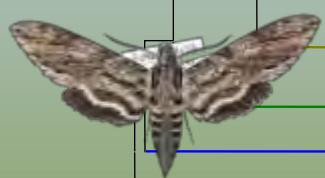
Integration de spécimens types

The *Sphinx lugens* complex

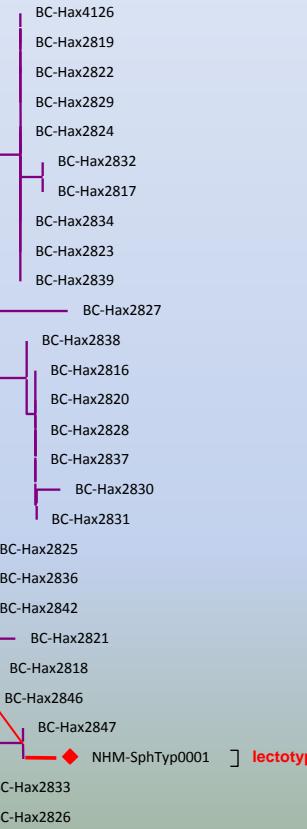


NHM, London
Lectotype of
Sphinx lugens

>150 y.o. – 120 bp



0.5 %



Sphinx lugens

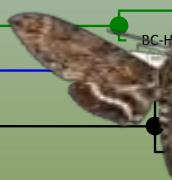


Sphinx geminus



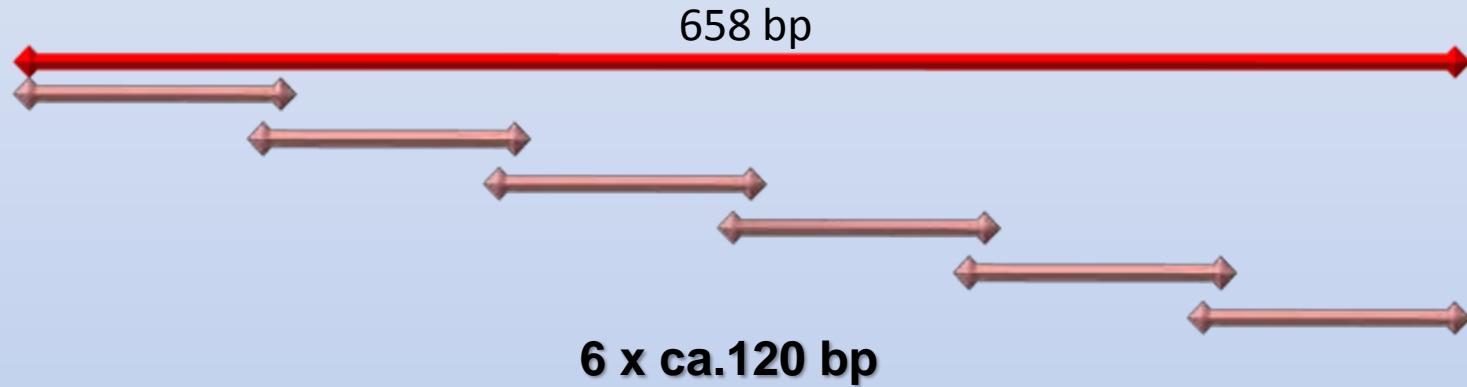
Sphinx n.sp.

Sphinx bolleyi



Integration de spécimens types

Nouveau protocole pour le séquencage de types anciens
(Rougerie et al., in prep)



Xylophanes virescens (Butler, 1875)

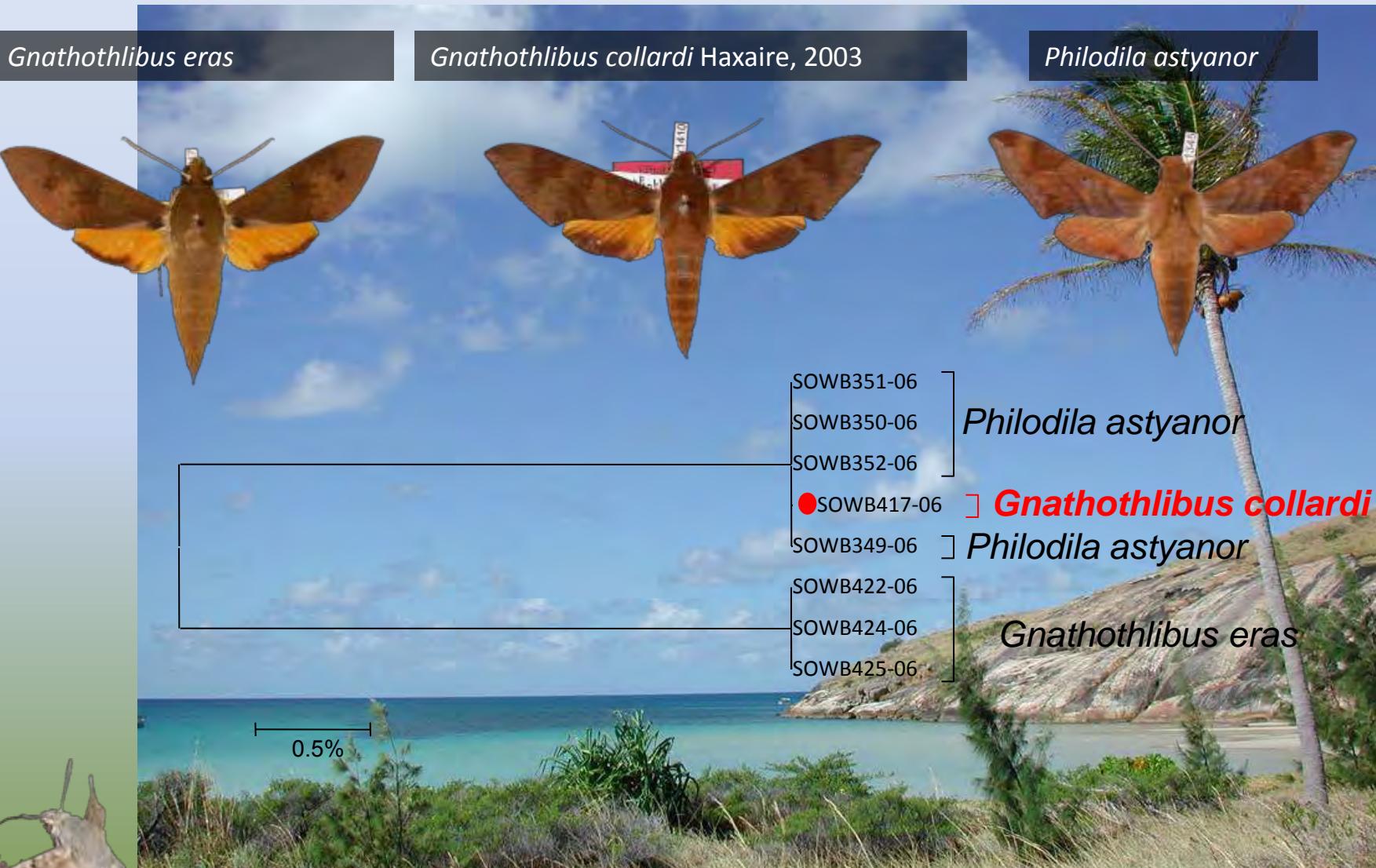
>130 y.o.



Sphinx lugens Walker, 1856

>150 y.o.

La campagne ‘Lépidoptères’



Les codes-barres ADN – au-delà de la taxonomie

MOLECULAR ECOLOGY

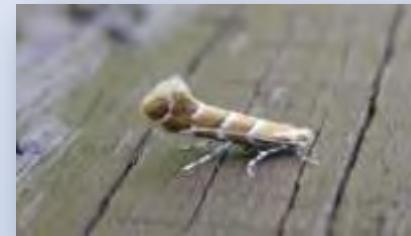
Molecular Ecology (2009) 18, 3458–3470

doi: 10.1111/j.1365-294X.2009.04290.x

Mitochondrial and microsatellite DNA markers reveal a Balkan origin for the highly invasive horse-chestnut leaf miner *Cameraria ohridella* (Lepidoptera, Gracillariidae)

R. VALADE,* M. KENIS,* A. HERNANDEZ-LOPEZ,* S. AUGUSTIN,* N. MARI MENA,*
E. MAGNOUX,* R. ROUGERIE,† F. LAKATOS,§ A. ROQUES* and C. LOPEZ-VAAMOND
*INRA, UMR633 Zoothologie Forestière, F-45075 Orléans, France, †CABI Europe-Suisse, 2900 Délémont, Switzerland,
§Canadian Centre for DNA Barcoding, Biodiversity Institute of Ontario, University of Guelph, 579 Gordon Street,
Ontario, N1G 2W1 Canada, §University of West-Hungary, Institute of Forest- and Wood Protection, H-9400 Szeged
12/C, Hungary

3464 R. VALADE ET AL.



Photos from flickR – felloff123 & Dave JG



Photo from flickR - Ombroso

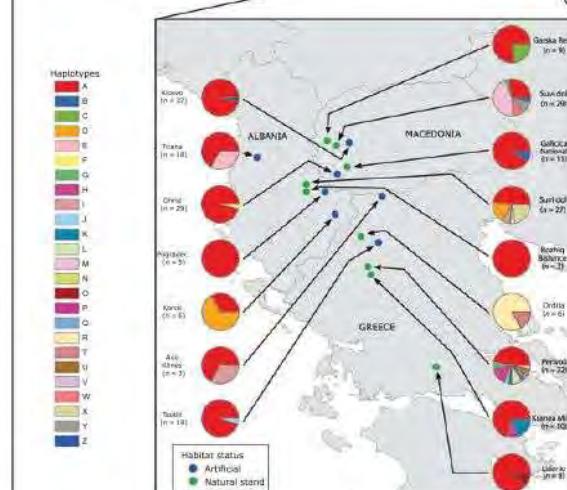
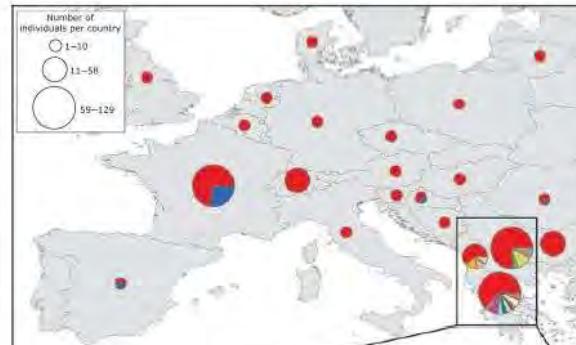
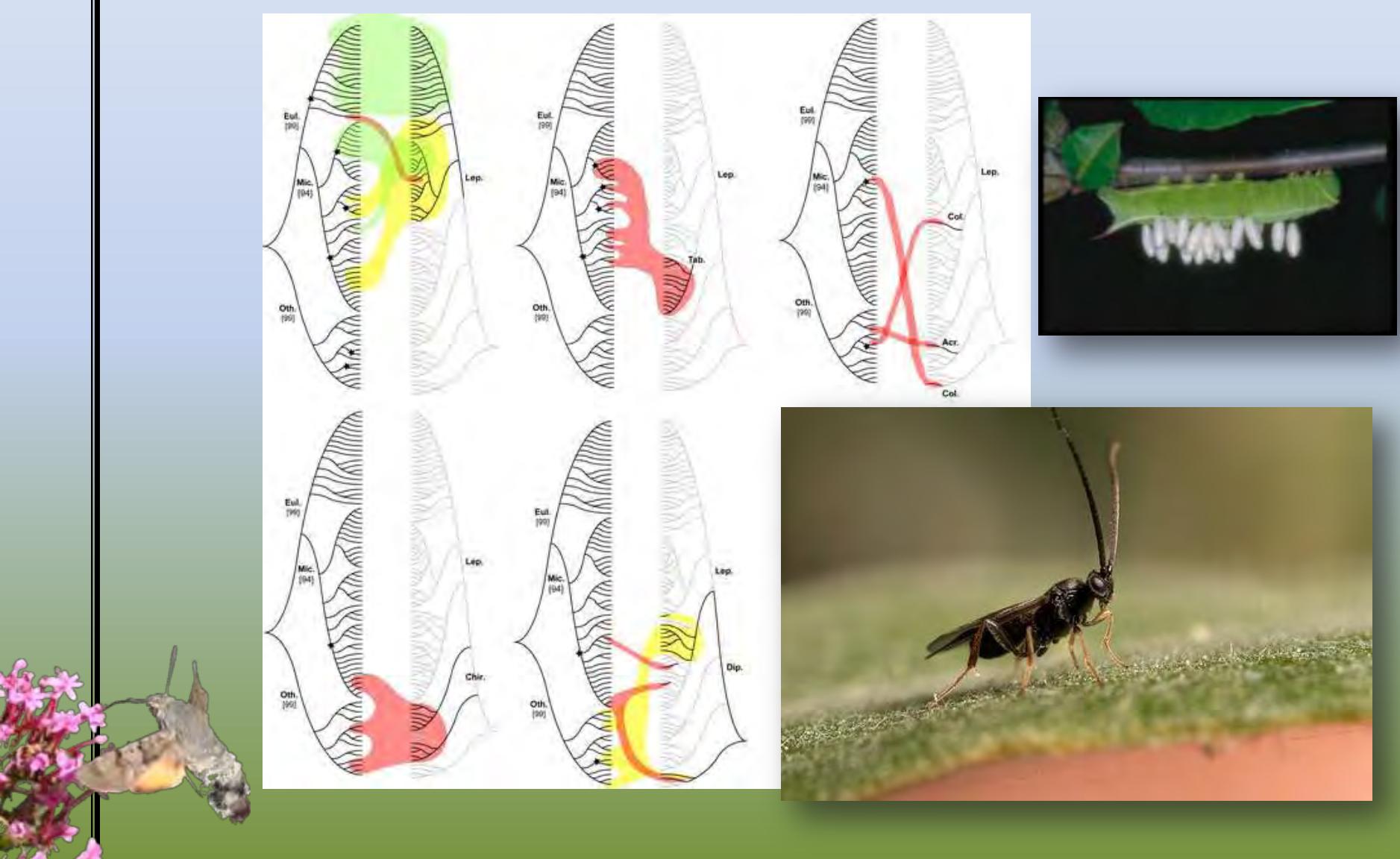


Fig. 2 Geographic distribution of the 25 haplotypes among the 22 sampled countries. Each pie chart represents a country and each haplotype is represented with a different colour. Number of individuals sampled per country is proportional to the size of each pie chart. For the southern Balkans, we illustrate the geographic distribution of the 25 haplotypes among 16 localities. Natural forests of *Aesculus hippocastanum* are represented by black circles and artificial habitats (i.e. planted trees in parks, gardens, along roads in urban or sub-urban areas) by blue circles. Number of individuals sampled per locality is indicated between parentheses.

Les codes-barres ADN – au-delà de la taxonomie

- Identification de l'hôte de guêpes parasitoides par l'analyse moléculaire du contenu de leur tube digestif (Rougerie et al., in prep)



Astraptes viracocha sp. nov.

Type locality. Costa Rica, Alajuela Prov. Area de Conservacion Guanacaste, Sector Cacao, Sendero Circular, 10.92714° N, 85.46683° W, 1185 m.

Diagnosis. The species may be differentiated from other members of the *Astraptes fulgerator* complex by the following unique character states of the DNA barcode: 379G; 389C; 391G.

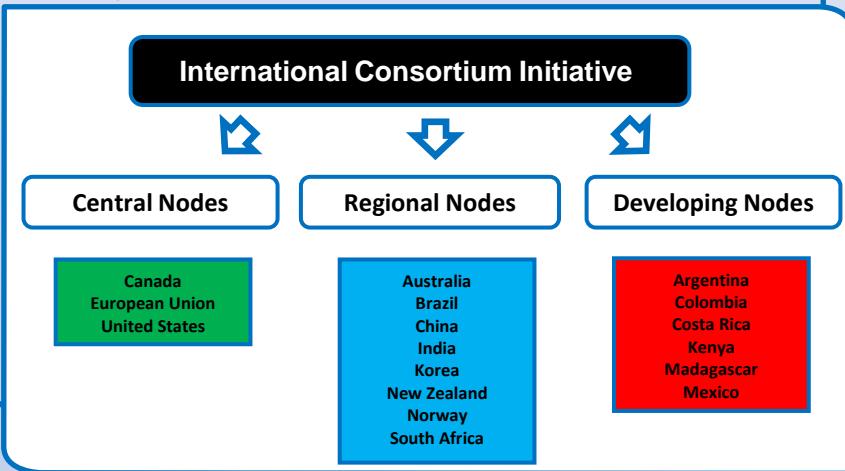
Holotype. Voucher 02-SRNP-24219, deposited at the University of Pennsylvania.

Note: This species corresponds to the OTU ‘LONCHO’ of Hebert *et al.* (2004).

Etymology. The name *viracocha*, a noun in apposition, is the name of a bearded white god of the Incas. The species is named for Dan Janzen.

iBOL - The international Barcode of Life project

Founding Members



10 Working groups

- WG1.1 – Vertebrates
- WG1.2 – Land plants
- WG1.3 – Fungi
- WG1.4 – Human pathogens
- WG1.5 – Pests & parasitoids
- WG1.6 – Pollinators
- WG1.7 – Freshwater life
- WG1.8 – Marine life
- WG1.9 – Terrestrial life
- WG1.10 – Polar life

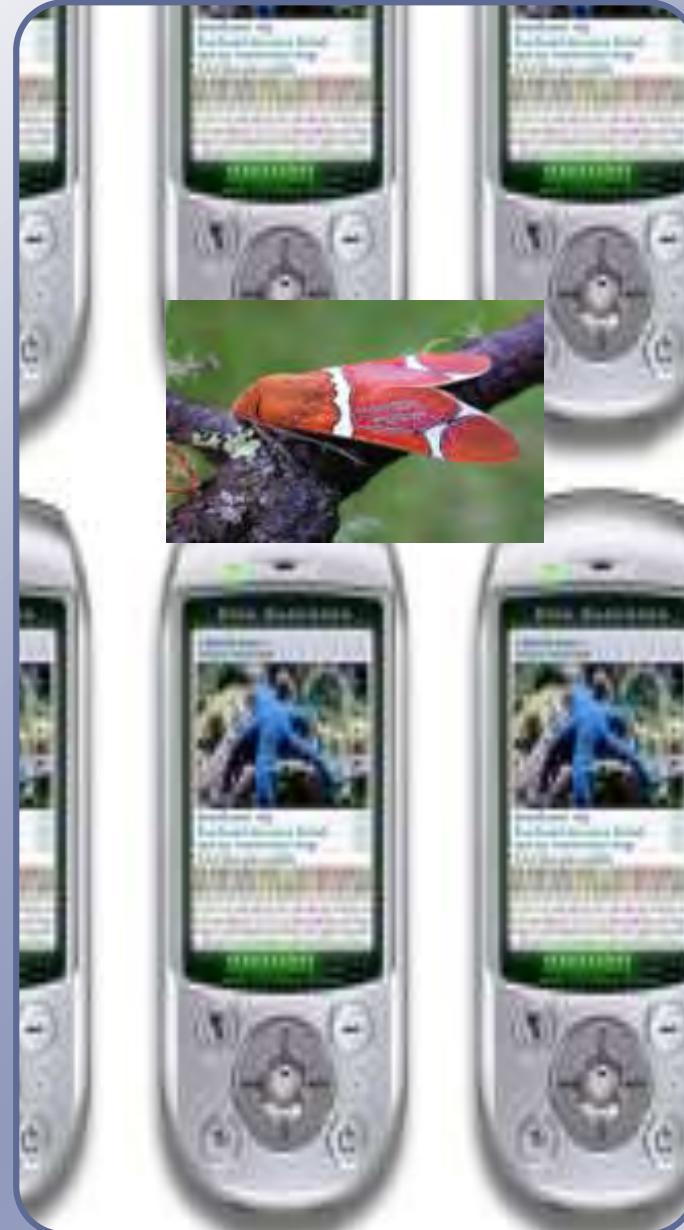
5M spécimens
500 000 espèces
En 5 ans

Total Funding \$150M

Central Nodes	> \$25M per node
Regional Nodes	> \$5M per node
Developing Nodes	> \$1M per node



Un guide de terrain pour le 3ème millénaire





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Kentrochrysalis heberti
Haxaire & Melichar 2010



Sujeevan Ratnasingham

Rodolphe Rougerie

Mehrdad Hajibabaei

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U.S.A.: Jeff Boettner, John W. Brown, Chris Conlan, Akito Kawahara, Scott Miller, Charlie & Kim Mitter, Ric Peigler, Jerry Regier, Kirby Wolfe, Jen Zaspel



Merci de votre attention

