

Chiropterologie



Kurz I

Tomáš Bartonička

Ústav botaniky a zoologie

Přf MU

Struktura kurzu

1. Informační zdroje. Chiropterologie jako vědní obor. Vymezení skupiny Chiroptera. Nejstarší fosilní záznam a bazální radiace. Strukturní charakteristiky a diverzita základních adaptací.
- 2.- 3. Morfologie a fylogeneze. Přirozená biodiverzita skupiny a přehled jednotlivých vývojových linií.
4. Ochrana netopýrů, současná rizika.
5. Echolokace

Důraz na metodické souvislosti a case examples

Význam a rizika letounů jako modelu

letouni - netopýři - dlouhověkost, 1-2 mláďata, vysoká socialita, specifické adaptace

monitoring a bioindikace - vysoká specializovanost

právní ochrana –

vyhláška č. 395/1992 Sb., zákon č. 114/1992 Sb., o ochraně přírody a krajiny.

Dohoda o ochraně netopýřů v Evropě (EUROBATS), dodatkem

Úmluvy o ochraně stěhovavých druhů volně žijících živočichů (Bonská úmluva).

kadavery po kolizi s automobilovou dopravou



Leptonycteris obalená pylem Agave

Význam a rizika letounů jako modelu

Ale...

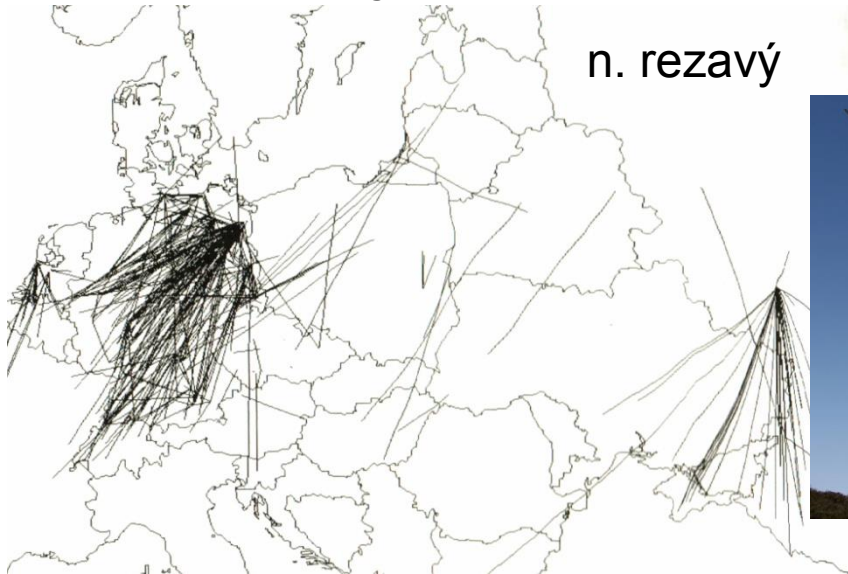
obtížně dostupné údaje o biologii \Rightarrow mnoho neznámého \Rightarrow **strach**



zásadní rozdílnosti v úrovni poznání - migrační koridory netopýřů a ptáků

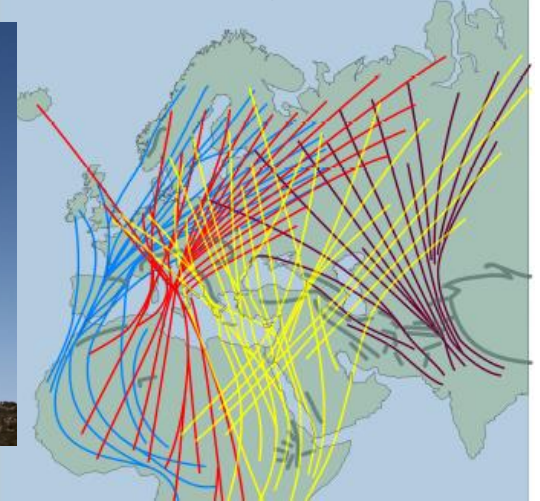
Netopýři

n. rezavý



Ptáci

European bird migration network



Zdroje informací

domácí knihy - Poznáváme naše savce, Létající savci, Naši netopýři, A tribute to bats

zahraniční knihy - atlasy poznávací, distribuční

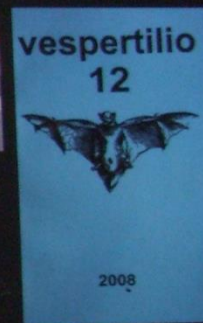
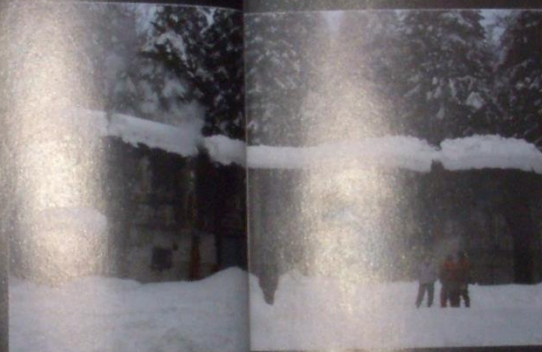
tématické knihy - echolokace, ekologie, biogeografie

časopisy a sborníky - Acta Chiropterologica, Acta Theriologica, Journal of Mammalogy, Myotis, Nyctalus, Folia Zoologica, Vespertilio, Lynx, informační letáky a brožury

historická literatura v českých zemích

ch Bat Conservation Trust
ination platform of bat research and bat conservation in
ormer Czechoslovakia, since 1993 in the Czech Republic

At beginning of the year 1994, in cooperation with bat students, a need of a formal platform for integration of regional bat studies with the projects of then newly establishes Environment Ministry (including international projects such as EUROBATS) and in care for continuity of the long-lasting monitoring of underground hibernacula, the Czechoslovak Bat Conservation Trust (Československá společnost pro ochranu netopýrů – ČESON) was established. After a split of former Czechoslovakia into the Czech Republic and Slovakia in 1993, the regional scope of ČESON is restricted to the Czech Republic and its role in Slovakia was taken by a newly established Slovak Bat Conservation Society (SON).



in care of two professional employees. Thanks to them ČESON started a large-scale programme of a strict control upon current rebuilding projects which might threat bat roosts and spread its focus onto huge number of local and regional bodies engaged in these projects.

For its members, ČESON provides a standard platform for presentation of particular outputs and promoting methodical innovations in study of bats. It organizes the annual plenary assemblies (with awarding particular achievements of young bat students with the F.A.Kolenati award), annual field meetings and

Since then ČESON is designed as a non-governmental non-profit organization

In cooperation with SON, it edits the journal Vespertilio founded in 1997.

15th International Bat Research Conference

* **The Biology of Bats at the Onset of the 21st Century** *

Prague, Czech Republic, 23-27 August 2010

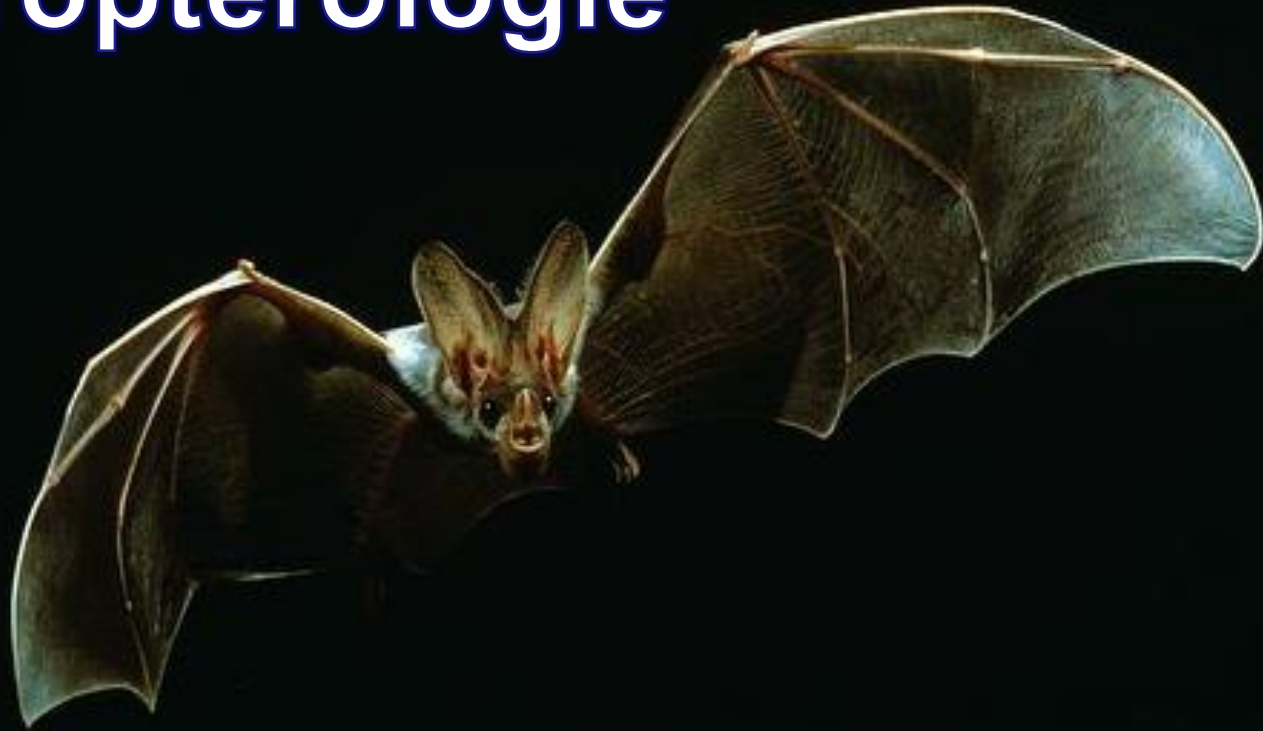


LIST OF INTERNATIONAL BAT RESEARCH CONFERENCES

| | | |
|------|------|-------------------------------|
| 1ST | 1968 | CZECHOSLOVAKIA, HLUBOKA N. V. |
| 2ND | 1970 | THE NETHERLANDS, AMSTERDAM |
| 3RD | 1972 | YUGOSLAVIA, PLITVICE |
| 4TH | 1975 | KENYA, NAIROBI |
| 5TH | 1978 | USA, ALBUQUERQUE |
| 6TH | 1982 | NIGERIA, IFE |
| 7TH | 1985 | UK, ABERDEEN |
| 8TH | 1989 | AUSTRALIA, SYDNEY |
| 9TH | 1992 | INDIA, MADURAI |
| 10TH | 1995 | USA, BOSTON |
| 11TH | 1998 | BRAZIL, PIRENOPOLIS |
| 12TH | 2001 | MALAYSIA, BANGI |
| 13TH | 2004 | POLAND, MIKOLAJKI |
| 14TH | 2007 | MEXICO, MERIDA |
| 15TH | 2010 | CZECH REPUBLIC, PRAHA |



Chiropterologie



**... samostatná zoologická
disciplína ?**

Google Scholar:

Bat 1.720.000

Mammal(s) 1.870.000

Rodent 813.000

Bird(s) 2.350.000

Fish 2.560.000

Bat Research 675.000

Mammal research 437.000

Mammalogy 64.200

Rodent research 531.000

Ornithology 133.000

Bird research 2.180.000

Ichthyology 121.000

Fish research 2.110.000



**Vrchol
rozmanitosti
přizpůsobení
mezi savci**



Historie oboru – tradiční důrazy na specifika netopýrů

(A) 19. stol. H.Kühl, Koch, Blasius, Kolenati ...

(B) Základy moderní chiropterologie (klasická díla): 30-50. léta 20. století

M.Eisentraut: Die deutsche Fledermäuse

G.M.Allen: Bats

A.P.Kuzyakin: Letučije myši

O.Ryberg: Studies on bats and bat parasites

.....

(C) Explozivní nárůst informací s novými technikami

70. léta – sítě

80. léta - detektory

90. léta – DNA

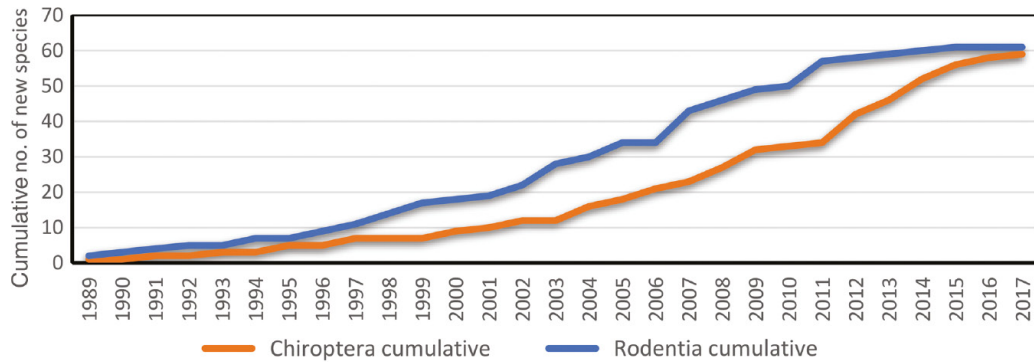
(D) Nyní: nejdynamičtější součást výzkumu savců

Letouni (Chiroptera) – druhý nejpočetnější řád savců

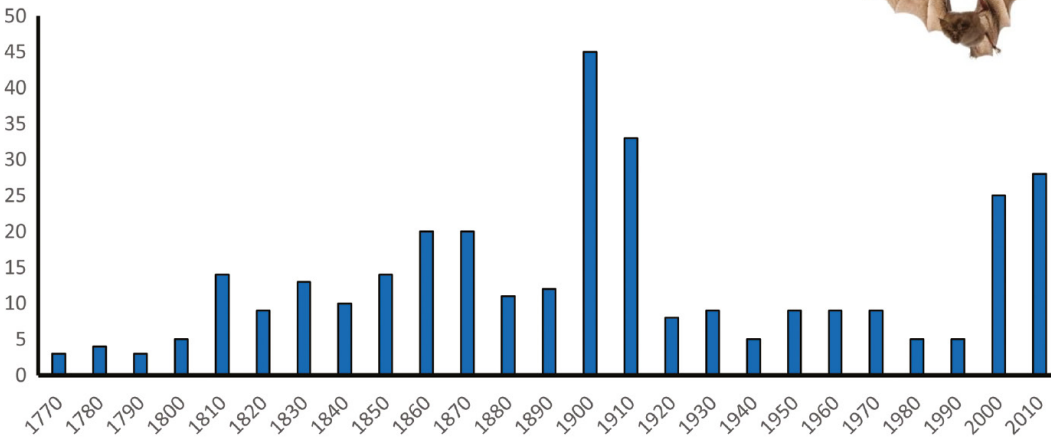
1382 druhů (9/2018)
(1250, 2014!)



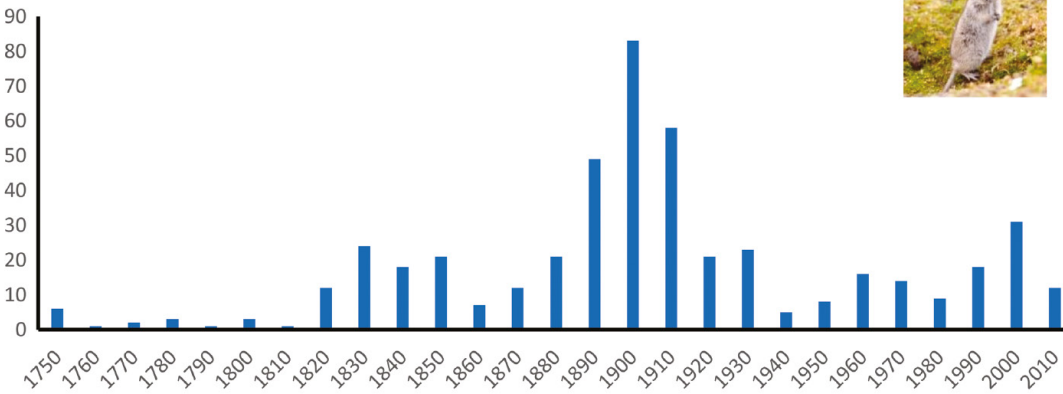
A New species descriptions since 1989

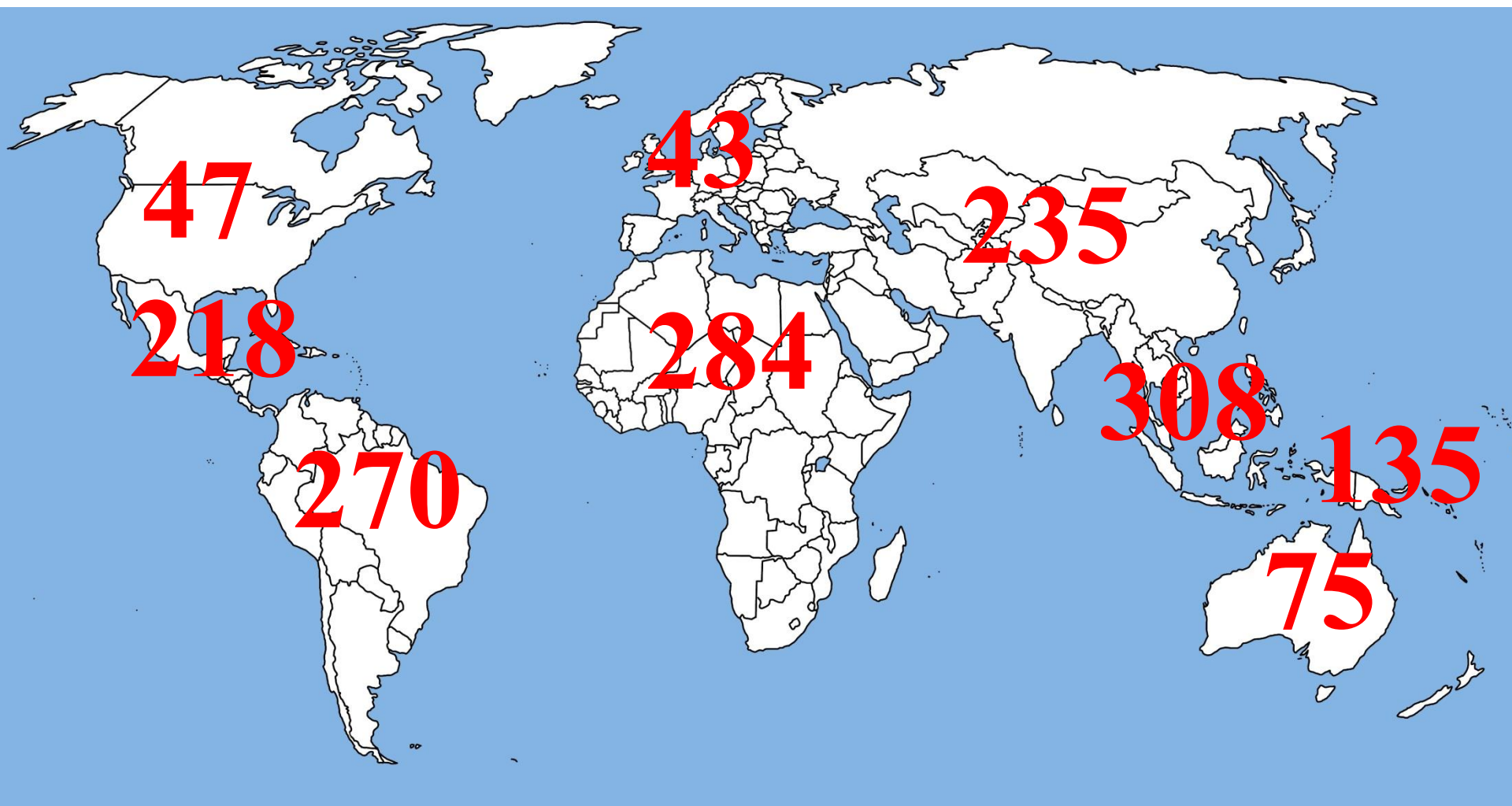


B African bat decadal species descriptions



C African rodent decadal species descriptions

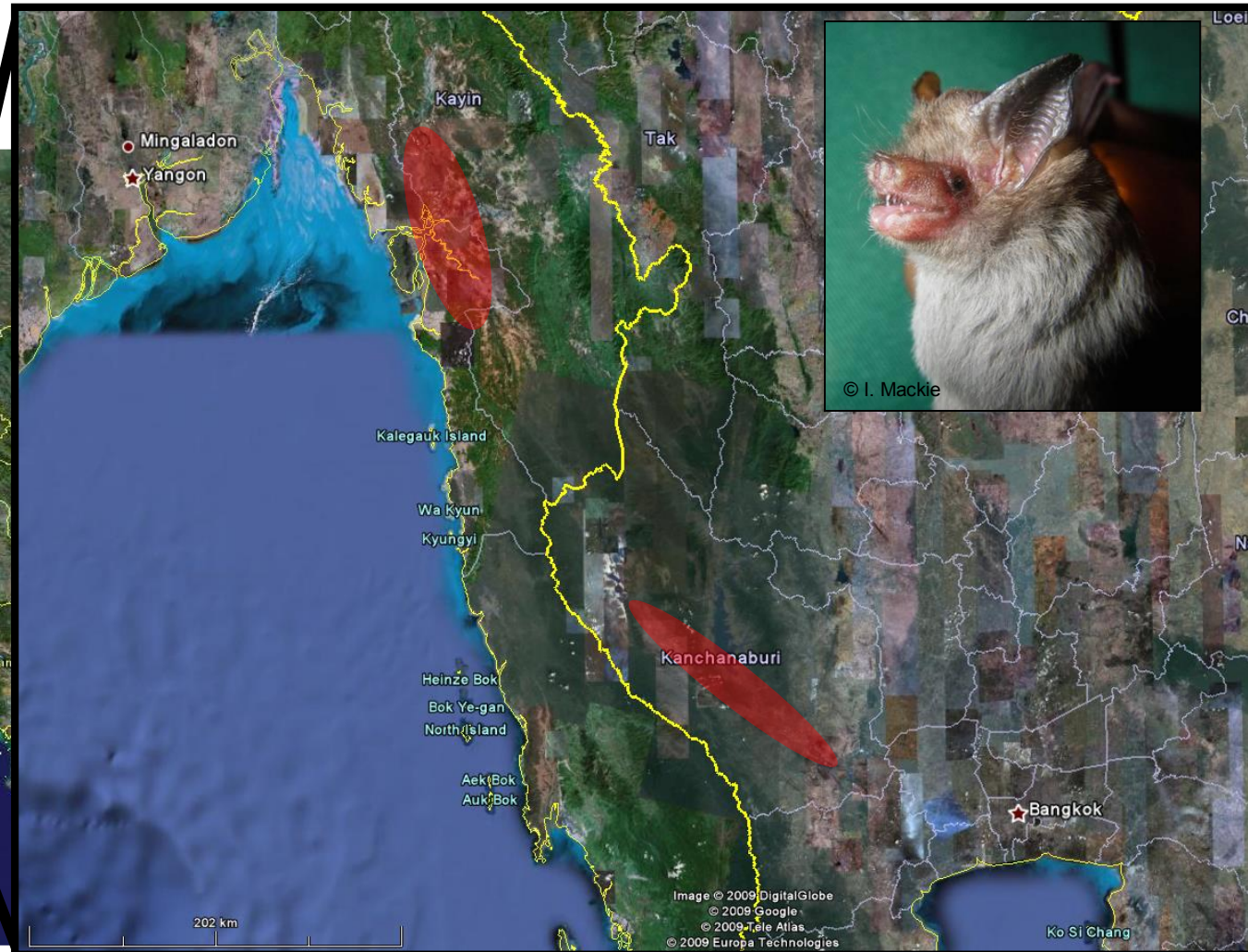
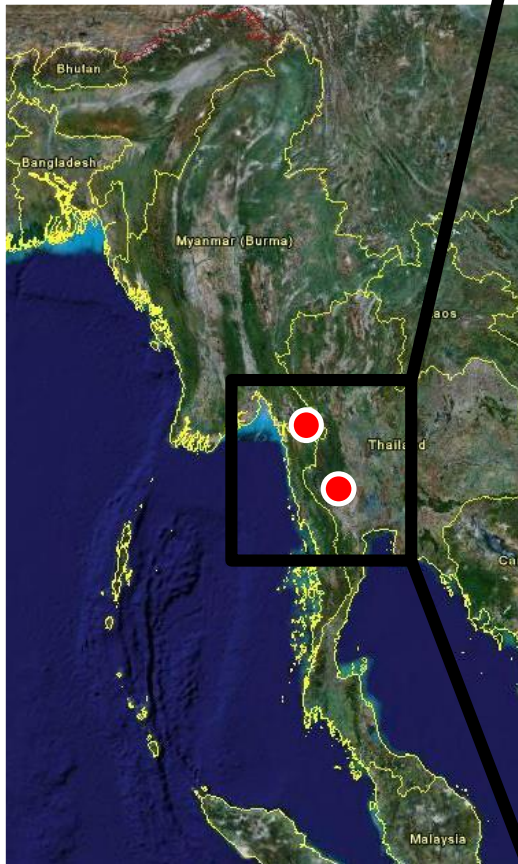




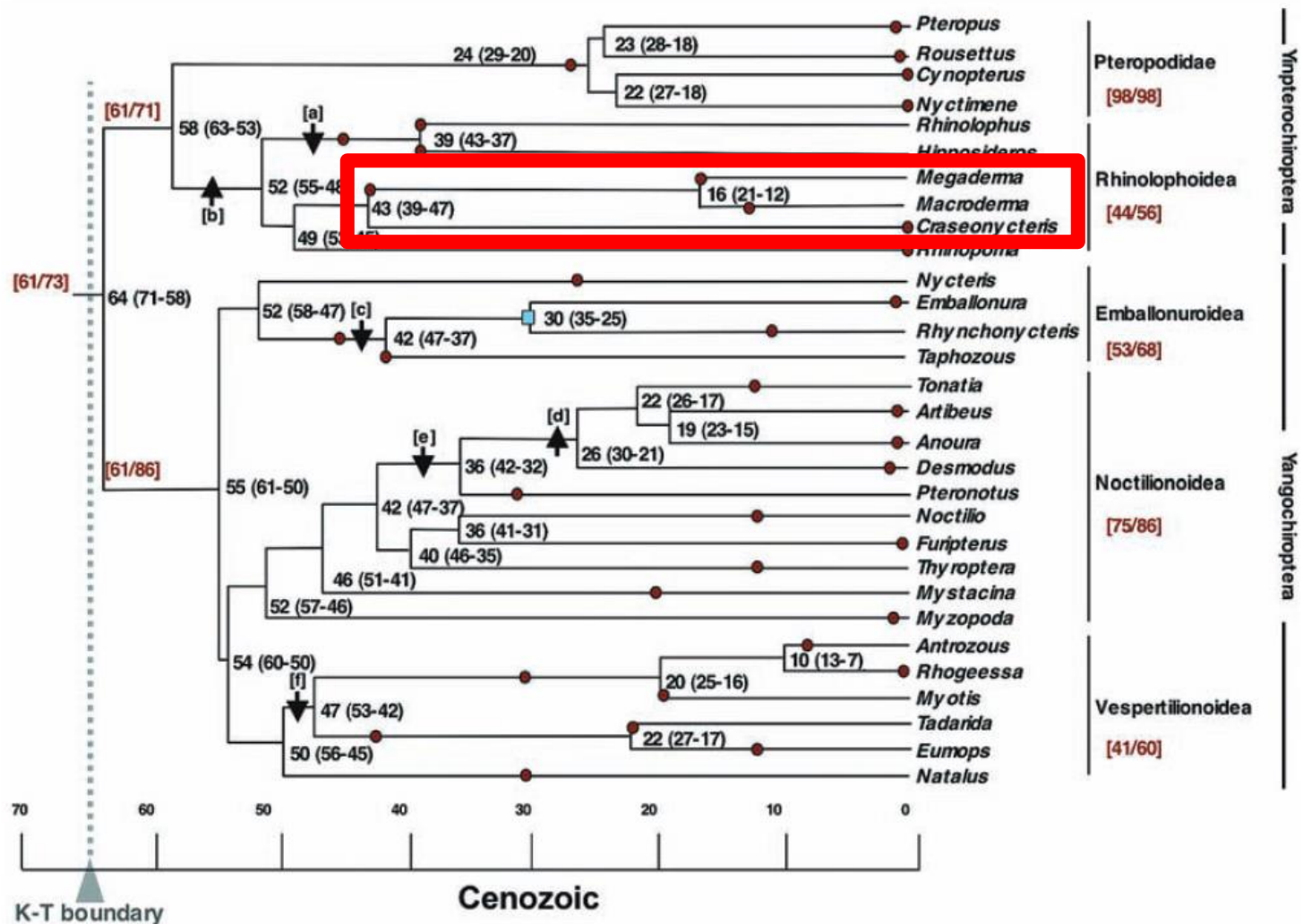
Naprostá většina netopýrů žije v tropech



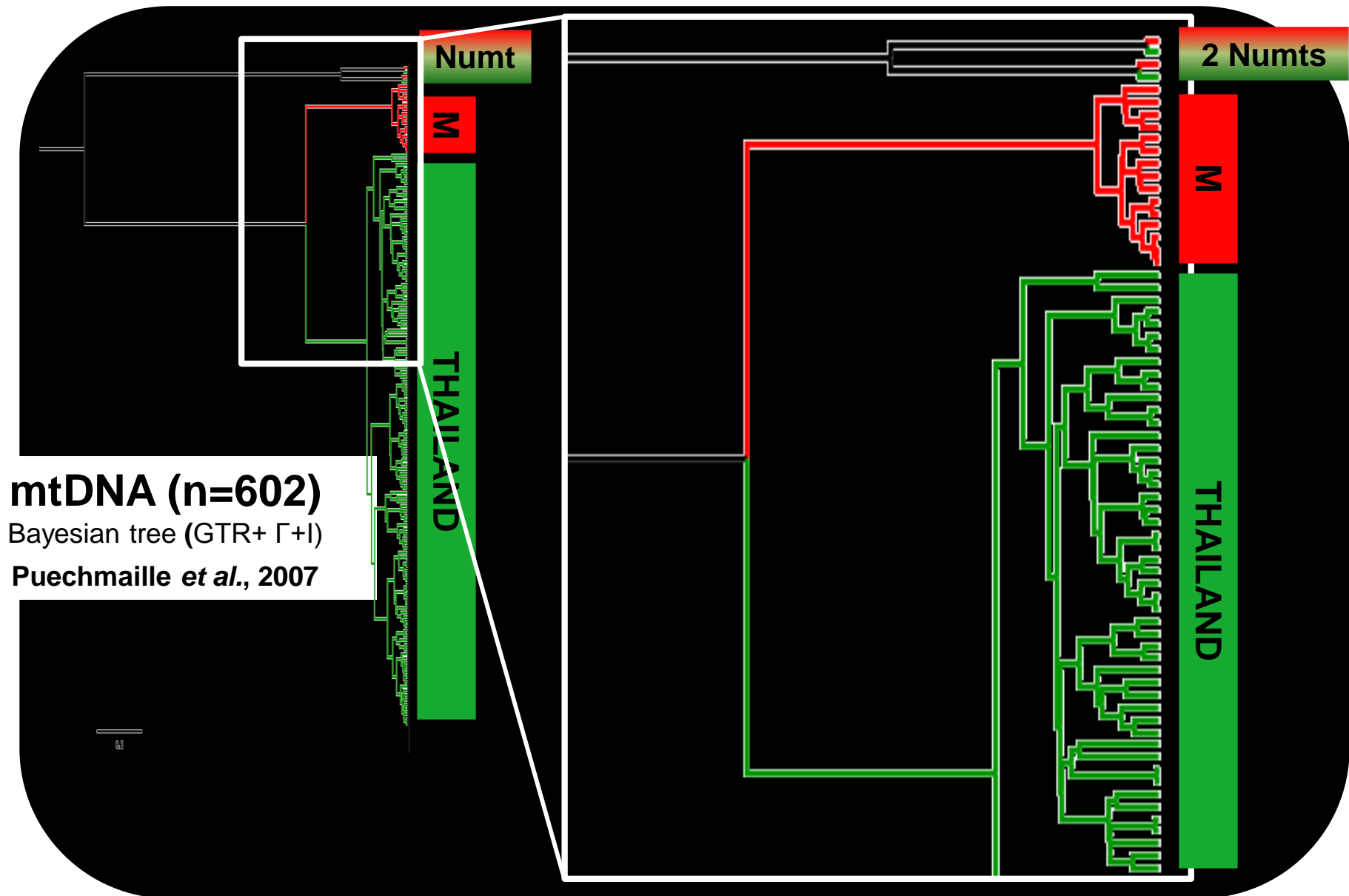
Craseonycteris thonglongyai – příklad « nej »



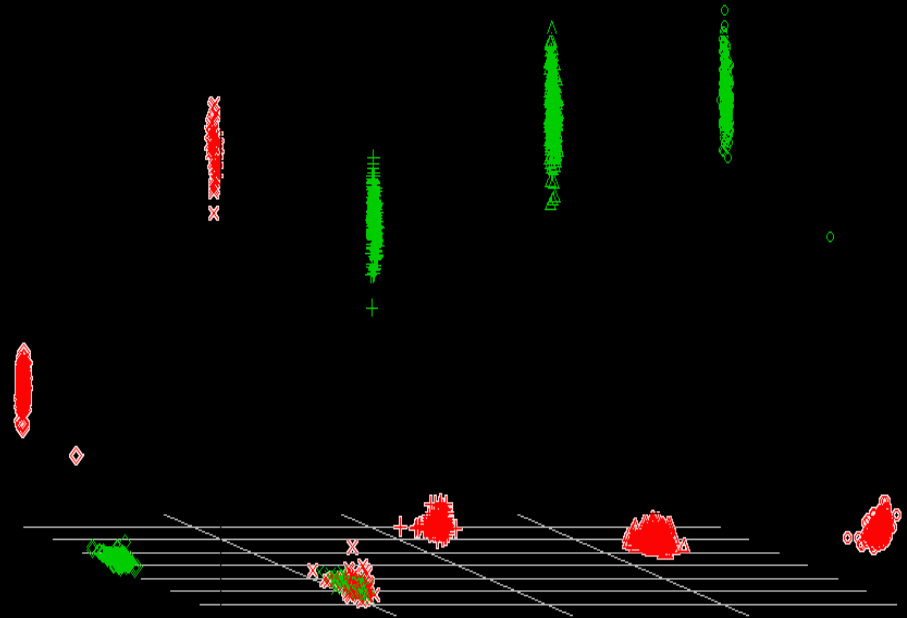
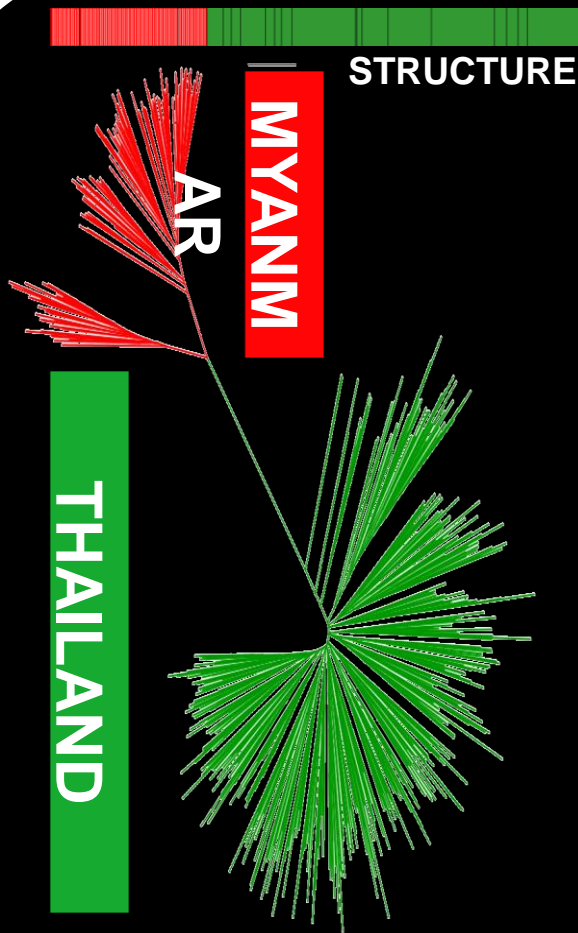
Craseonycteridae



Thailand versus Myanmar ...



Nuclear support



Microsatellites (n=659)

NJ tree (Da distance, Nei 1983)

5 SNPs (n=659) (**463**

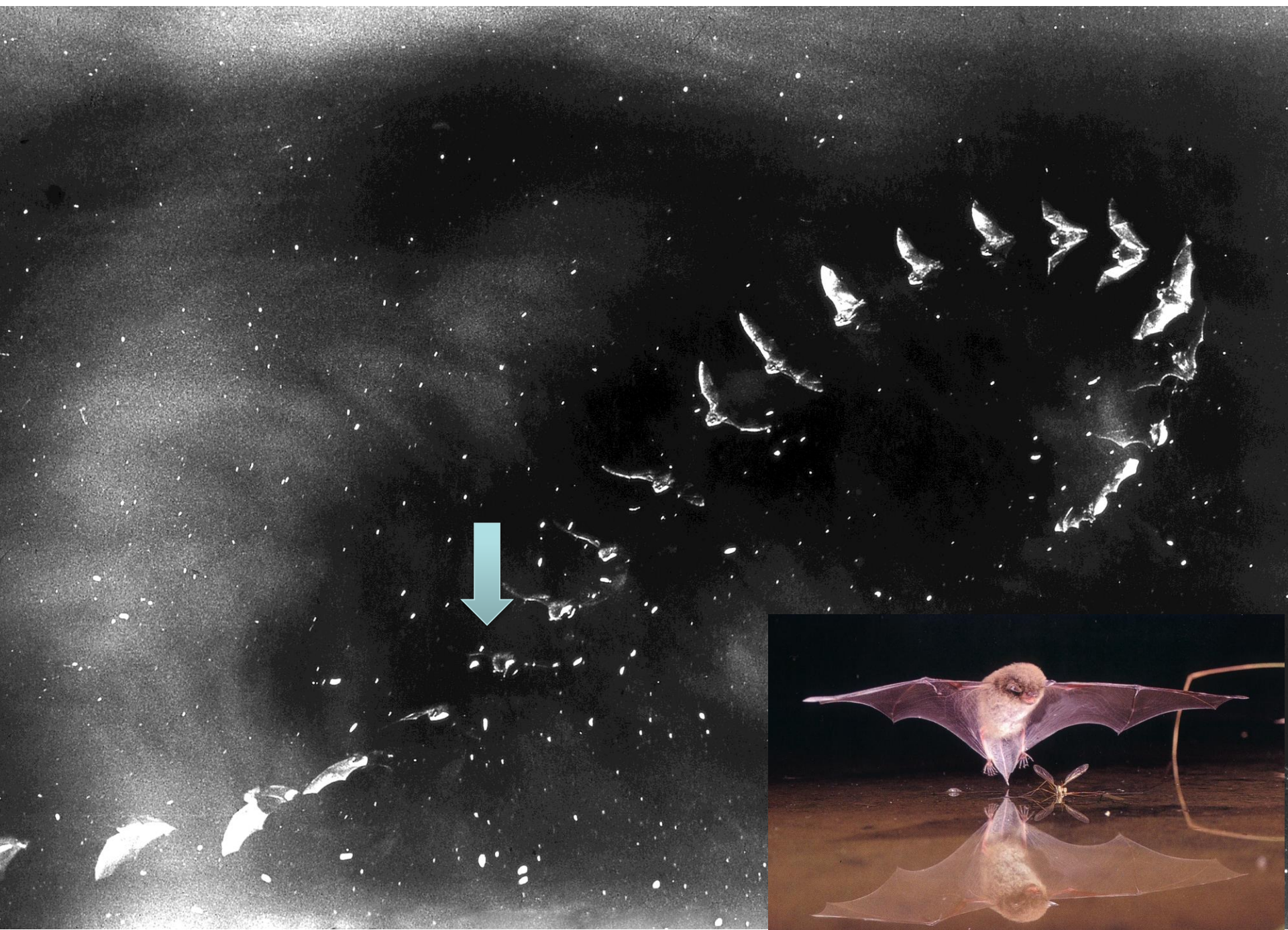
Thai, 196 Myanmar)

Vymezení (eidologické) netopýra



Schopnost aktivního letu



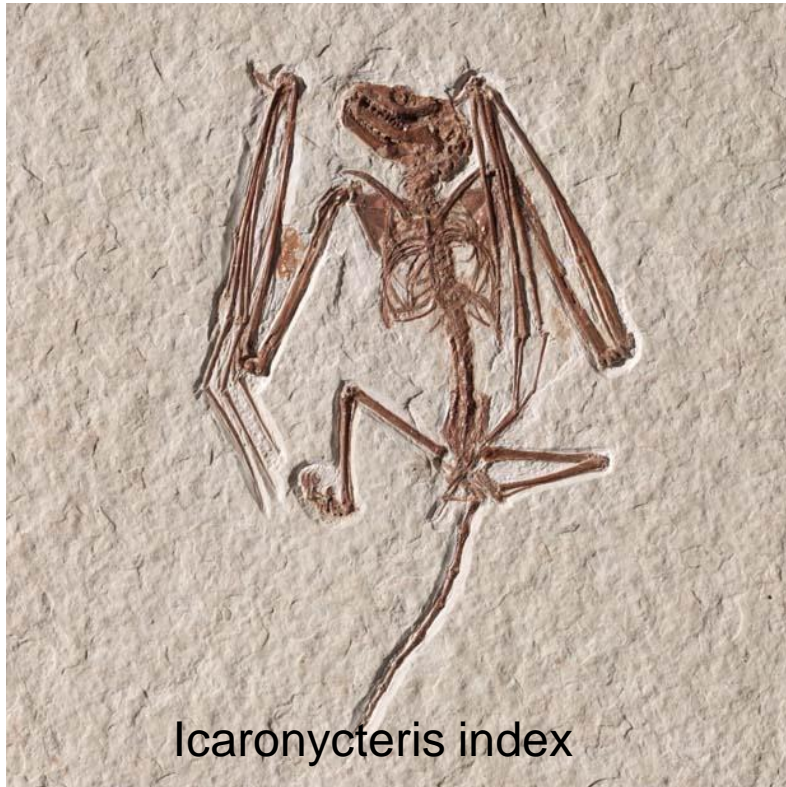


70% fosilního záznamu chybí

ale Eocén

**Icaronycteris, Palaeochiropteryx, Archaeonycteris,
Hassianycteris, Tachypteron**

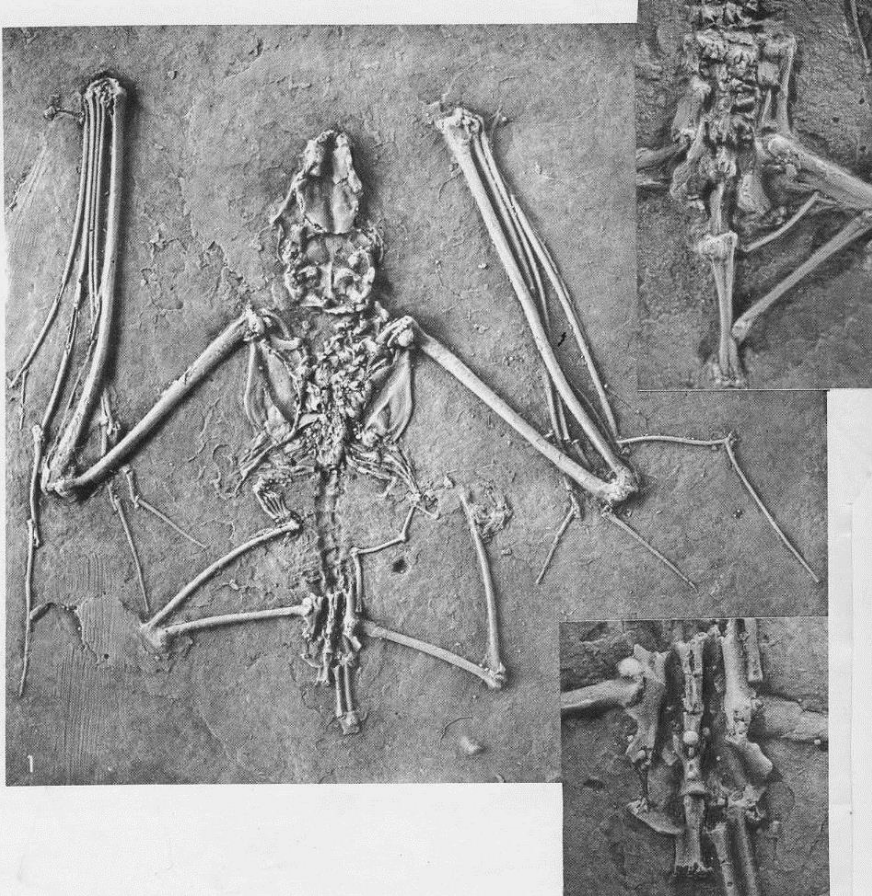
Wyoming, USA, 52,2 mya



Icaronycteris index

**schopnost letu i
laryngeální echolokace**

**kosti křídla,
hlemýžd', kladívko...**



1917 *Palaeochiropteryx
tupaiodon* Revilliod

MEMOIRES
DE LA
SOCIÉTÉ PALÉONTOLOGIQUE SUISSE
VOLUME XLIV (1919)

CONTRIBUTION A L'ÉTUDE

DES

CHIROPTÈRES

DES TERRAINS TERTIAIRES

PAR

Pierre REVILLIOD.

DEUXIÈME PARTIE

Avec 2 planches et 16 figures dans le texte.

GENÈVE
IMPRIMERIE ALBERT KUNIG, RUE DU VIEUX COLLÈGE, 4

1920

Phosphorites du Quercy



Messel Pit (near Darmstadt, Germany)



[Úvod](#) › [Navštivte nás](#) › [Palác šlechtičen](#) › [Výstavy](#) › Messel on Tour

NAVŠTIVTE NÁS

Dietrichsteinský palác

Biskupský dvůr

Palác šlechtičen

Výstavy

Messel on Tour

V utrpení a boji

Jamim mikedom

Mendelianum

Pavilon Anthropos

Památník Leoše Janáčka

Památník Bible královo

Messel on Tour – přírodní katastrofa po zániku dinosaurů



Od 6. ledna do 8. dubna 2012

Výstava 125 originálů zkamenělin ze slavné německé lokality Messel (stát Hesensko). Od poloviny 19. století na tomto místě probíhala rozsáhlá těžba živičných jílovců, která skončila v 70. letech minulého století. Dnes je lokalita vzhledem k unikátním nálezům zkamenělin pod přísnou ochranou organizace UNESCO.

Samotná výstava Messel on Tour je dílem kolegů z Hessisches Landesmuseum Darmstadt, kteří mají odborný dohled na pokračující paleontologický výzkum. Zkameněliny z Messelu jedinečně dokumentují raná stádia evoluce savců. Bylo zde objeveno na 45 jejich druhů (předchůdce dnešního koně, netopýři, vačice, lemurovití savci, hlodavci i primitivní mravenečník). Lokalitu proslavil i objev fosílie Darwinius masillae pokládaná za jednoho z prvních primátů tedy i vývojové větve vedoucí k člověku. Vedle savců je lokalita věhlasná nálezy ptáků, krokodýlů, hadů, žab i hmyzu.





Hyrachyus minimus

Eurotamandua joresi





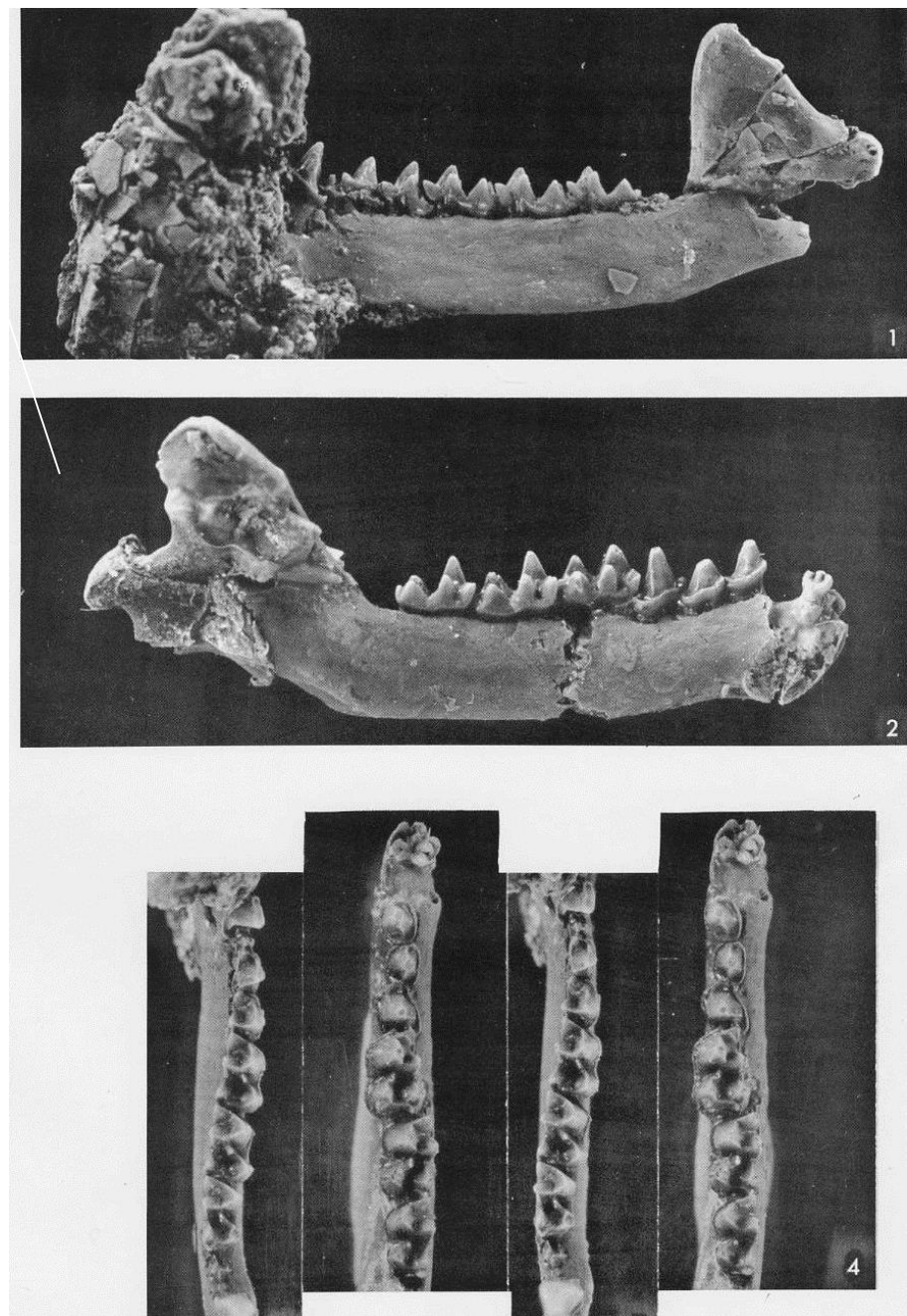
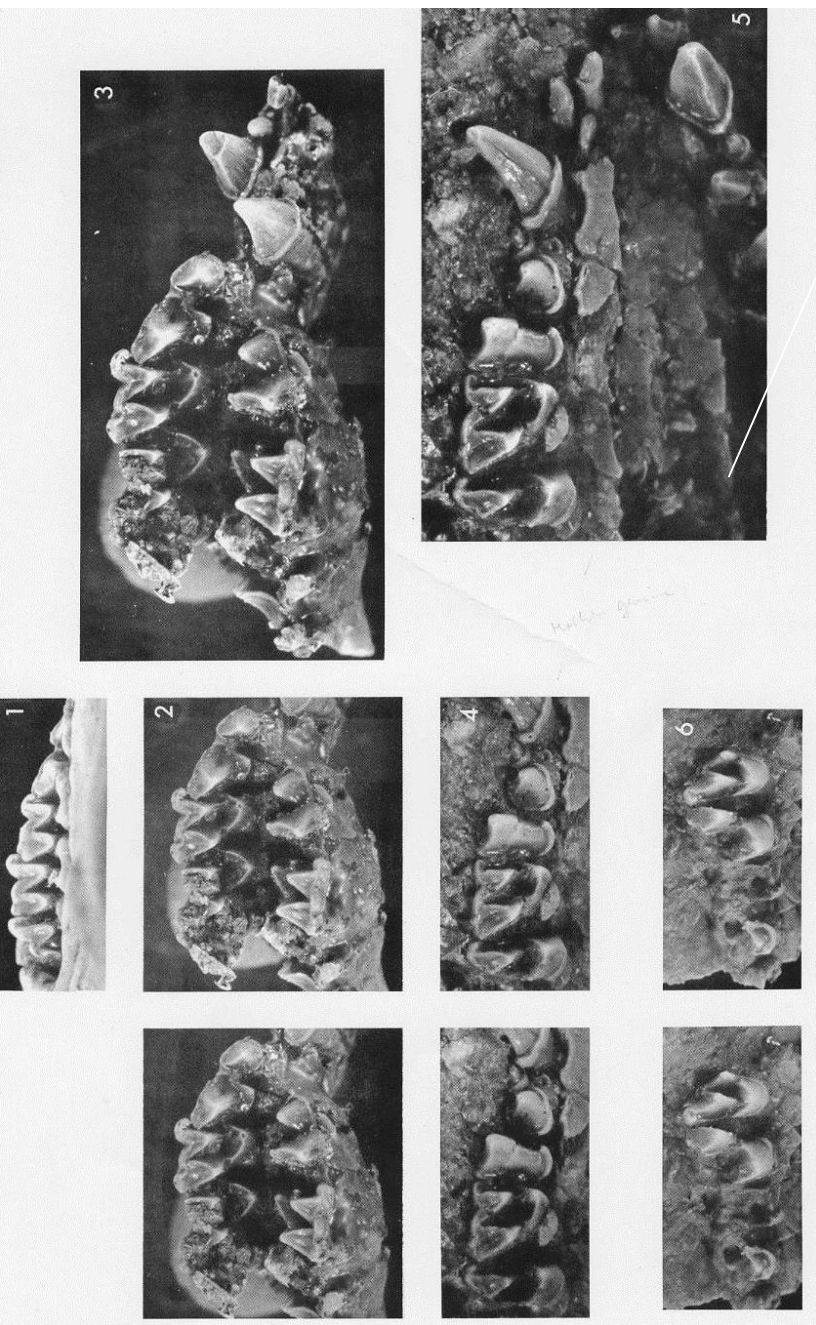
Propalaeotherium hassiacum

Messel Bats - Palaeochiropterygidae

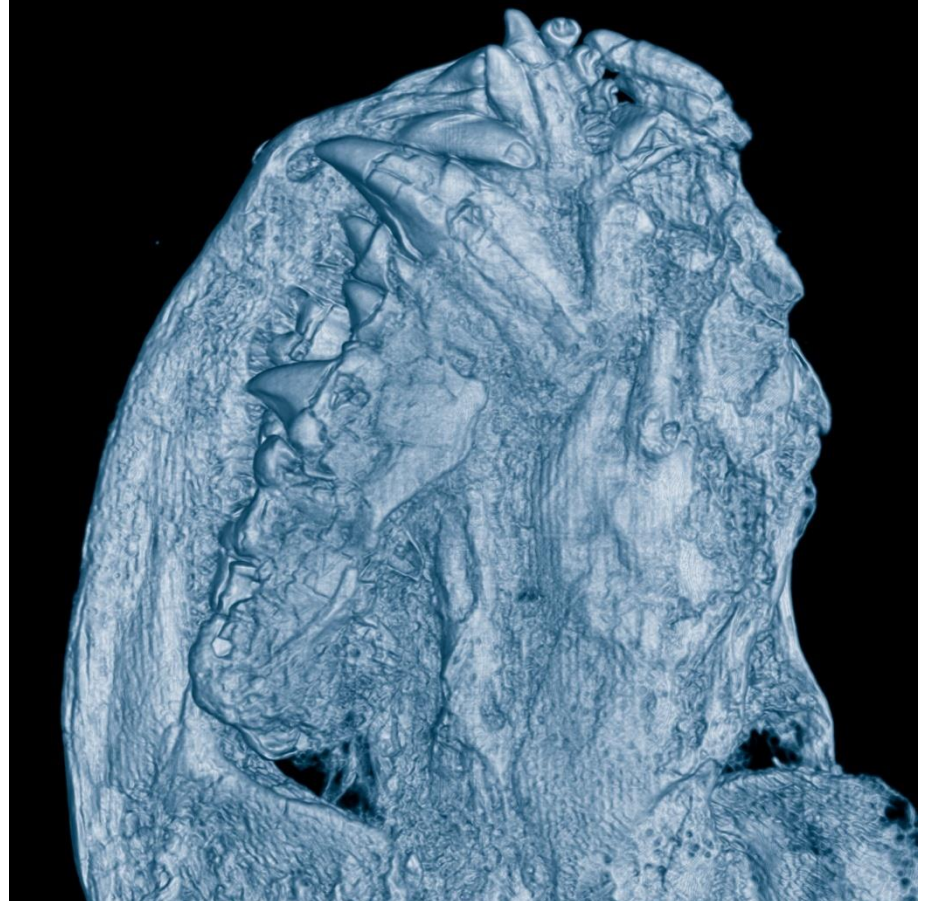
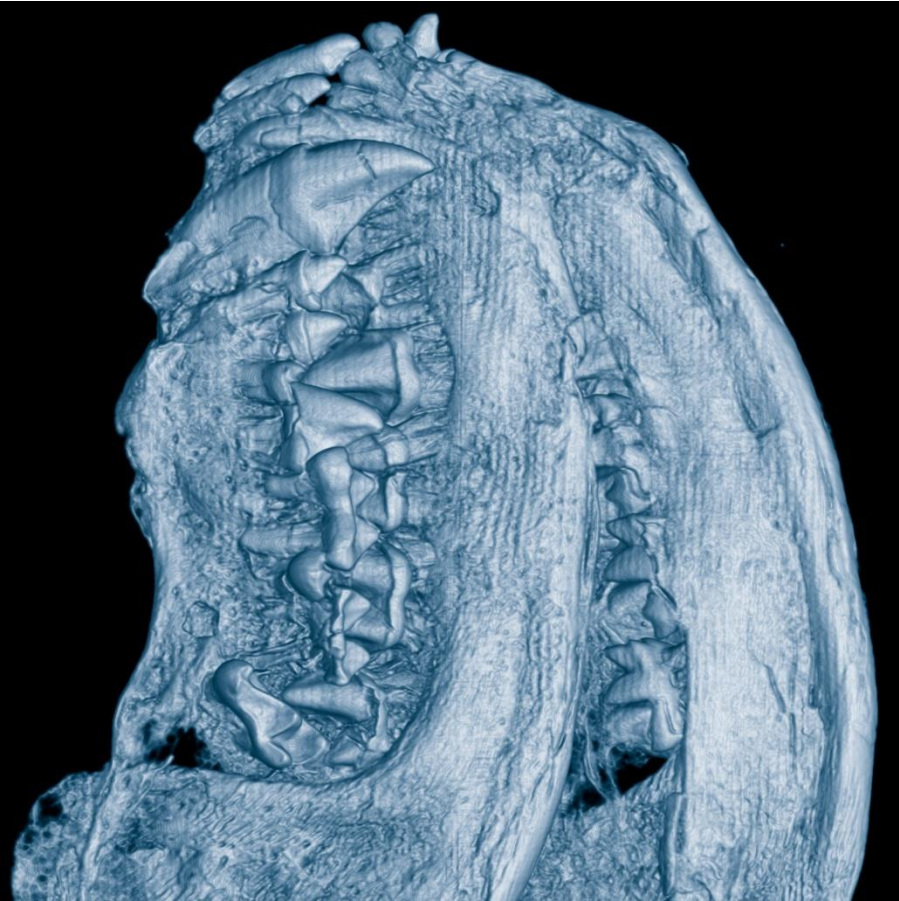


Palaeochiropteryx tupaiodon (SMF 2022)

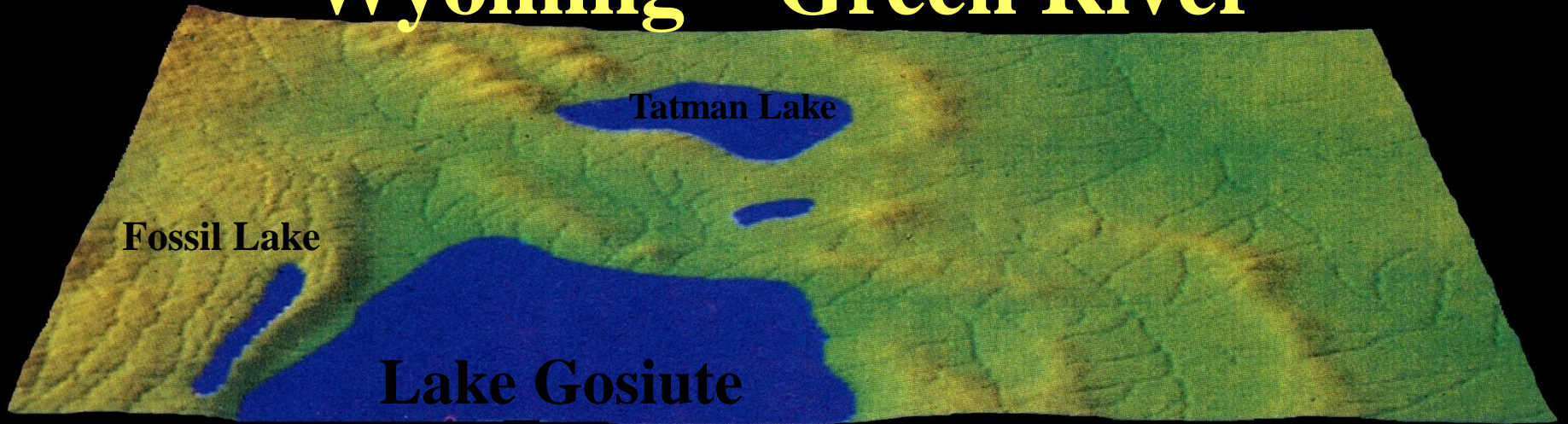
Geiseltal: *Cecilionycteris prisca*, *Matthesia insolita*



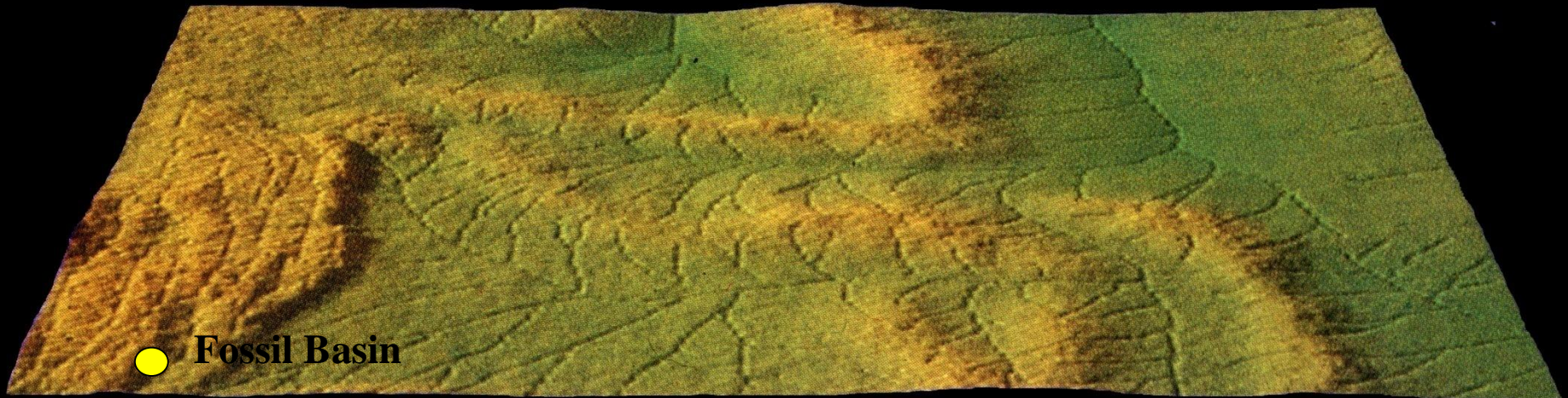
Archaeonycteris Dentition



Wyoming – Green River



Late Early - Middle Eocene

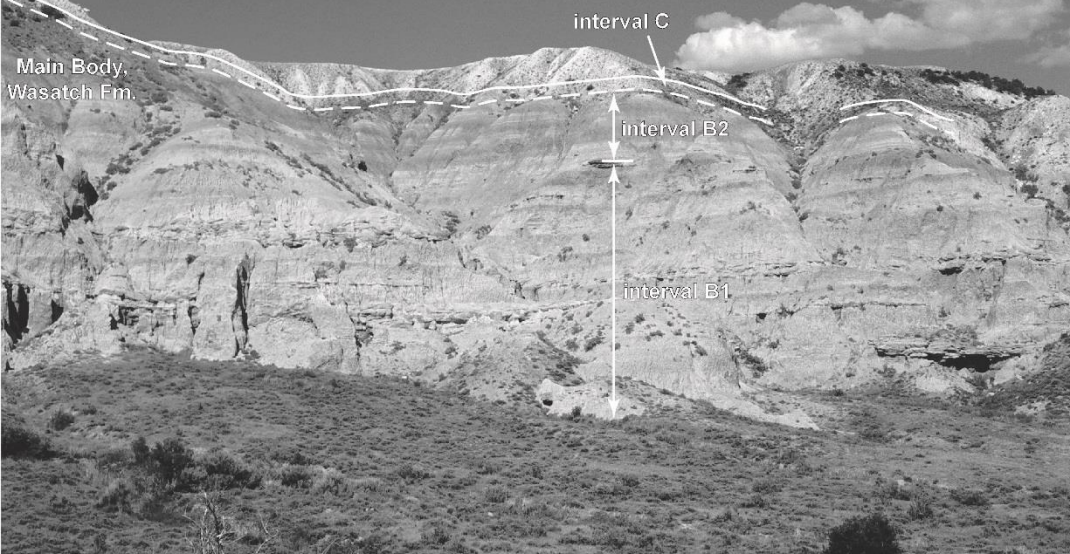


Early Eocene

A.

Fossil Butte Member,
Green River Fm.

Main Body,
Wasatch Fm.



B.



Icaronycteris index

Do nedávna nejstarší známá fosilie,
sp. eocén.
Už hotový netopýr, cf. mj. malá
redukce ulny

Evropská organizace pro jaderný výzkum
(CERN)

14 February 2008 | www.nature.com/nature | \$10

THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

nature



NANODEVICES
In search of power

REAL ECOSYSTEMS
It's chaos out there

SPEED DATING
The rules of the game

FLIGHT FIRST

Solving the mysteries
of bat evolution

**TECHNOLOGY
FEATURE**
Stem-cell culture

\$10.00US \$12.99CAN



0 71486 03070 6

Onychonycteris finneyi

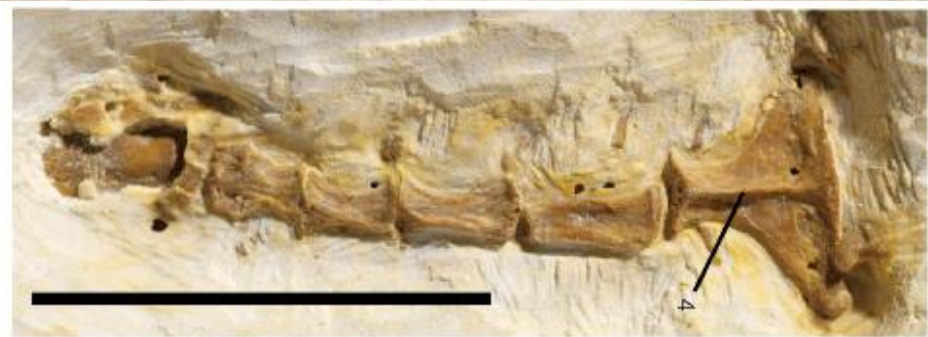


Paratype (Private Collection)

Icaronycteris index



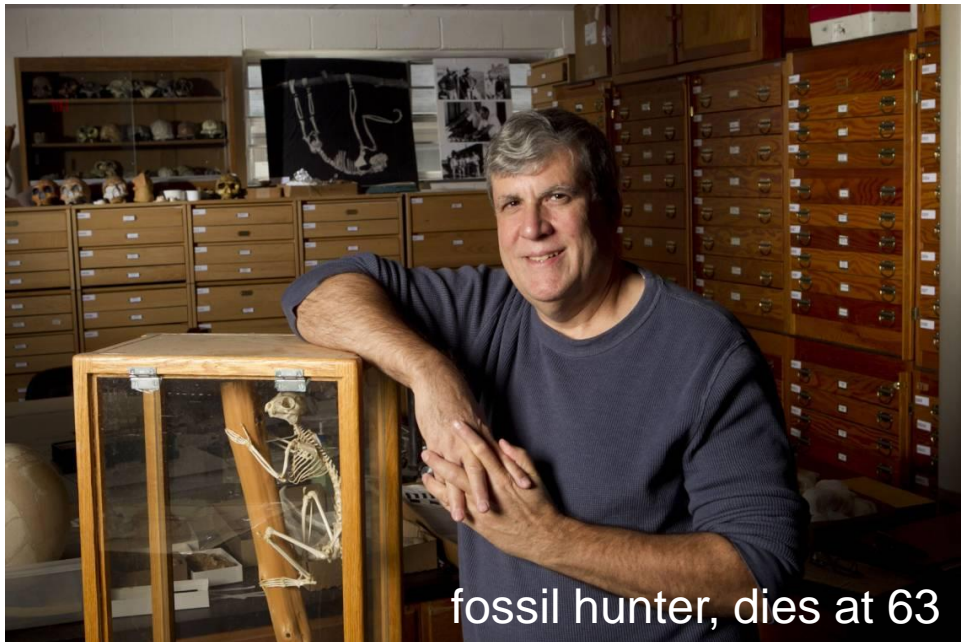
Holotype (YPM-PU 18150)



Ale...*Onychonycteris finneyi*

1. Gunnell 2008, Nature

nemá základní struktury nutné pro echolokaci



fossil hunter, dies at 63

2. Veselka et al. 2010

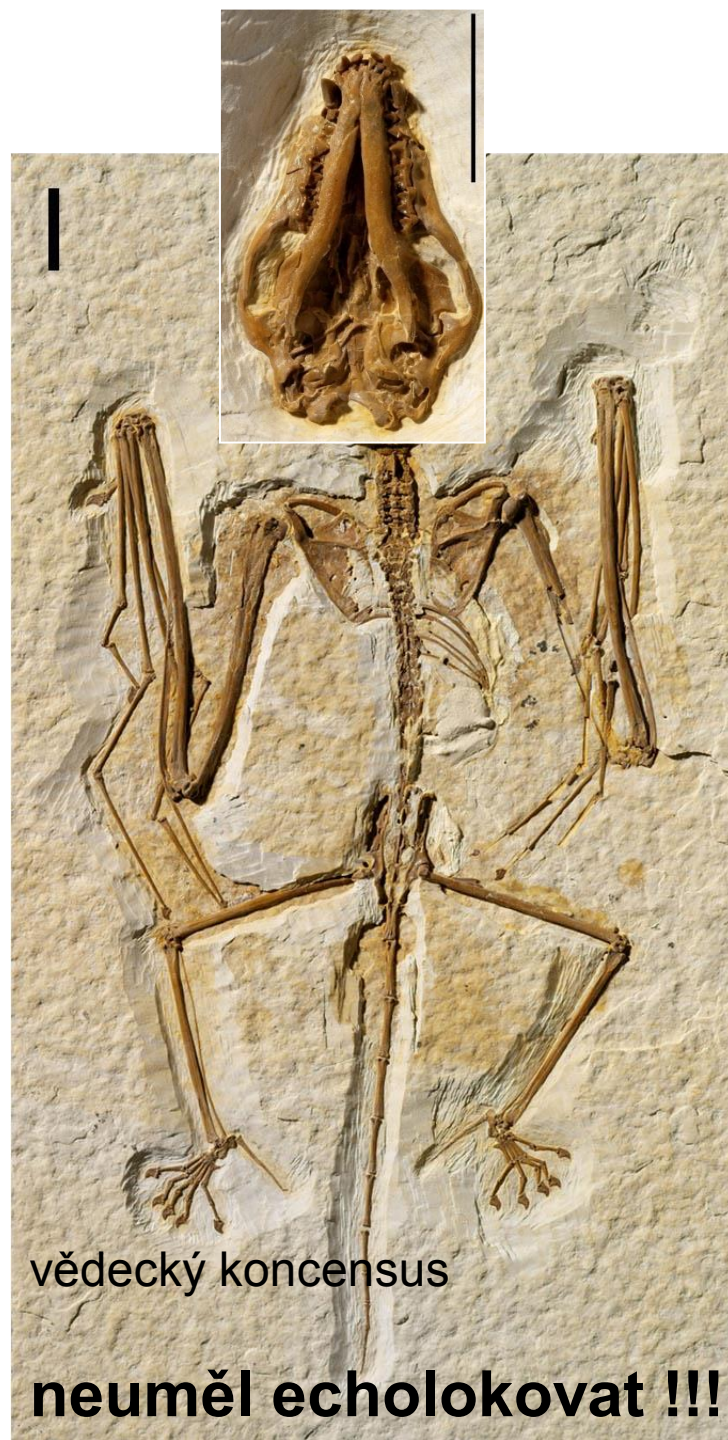
u kaloňů a neecholokujících

stylohyal (bodcovitý výběžek jazyčky)

není pevně spojen s tympanem

ale *Onychonycteris* spoj má!

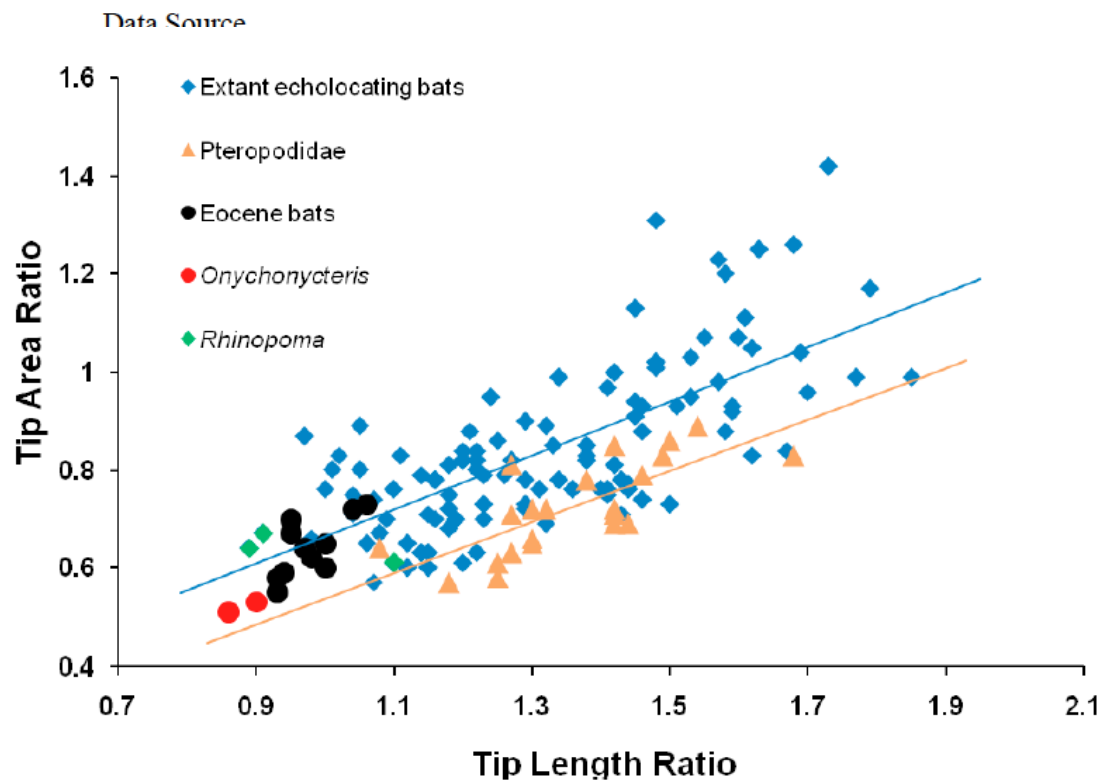
Diurnální aktivita? Oči?

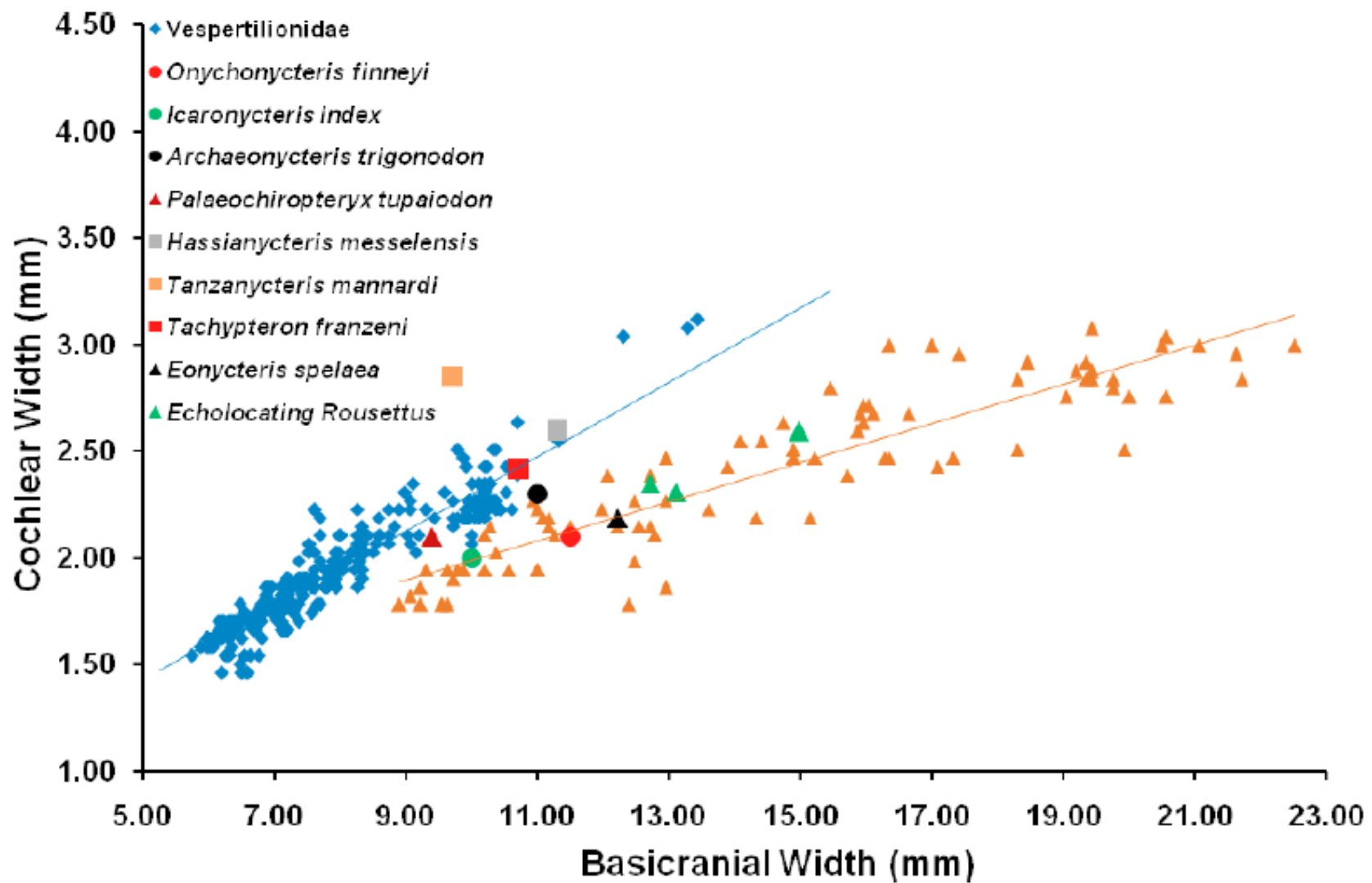


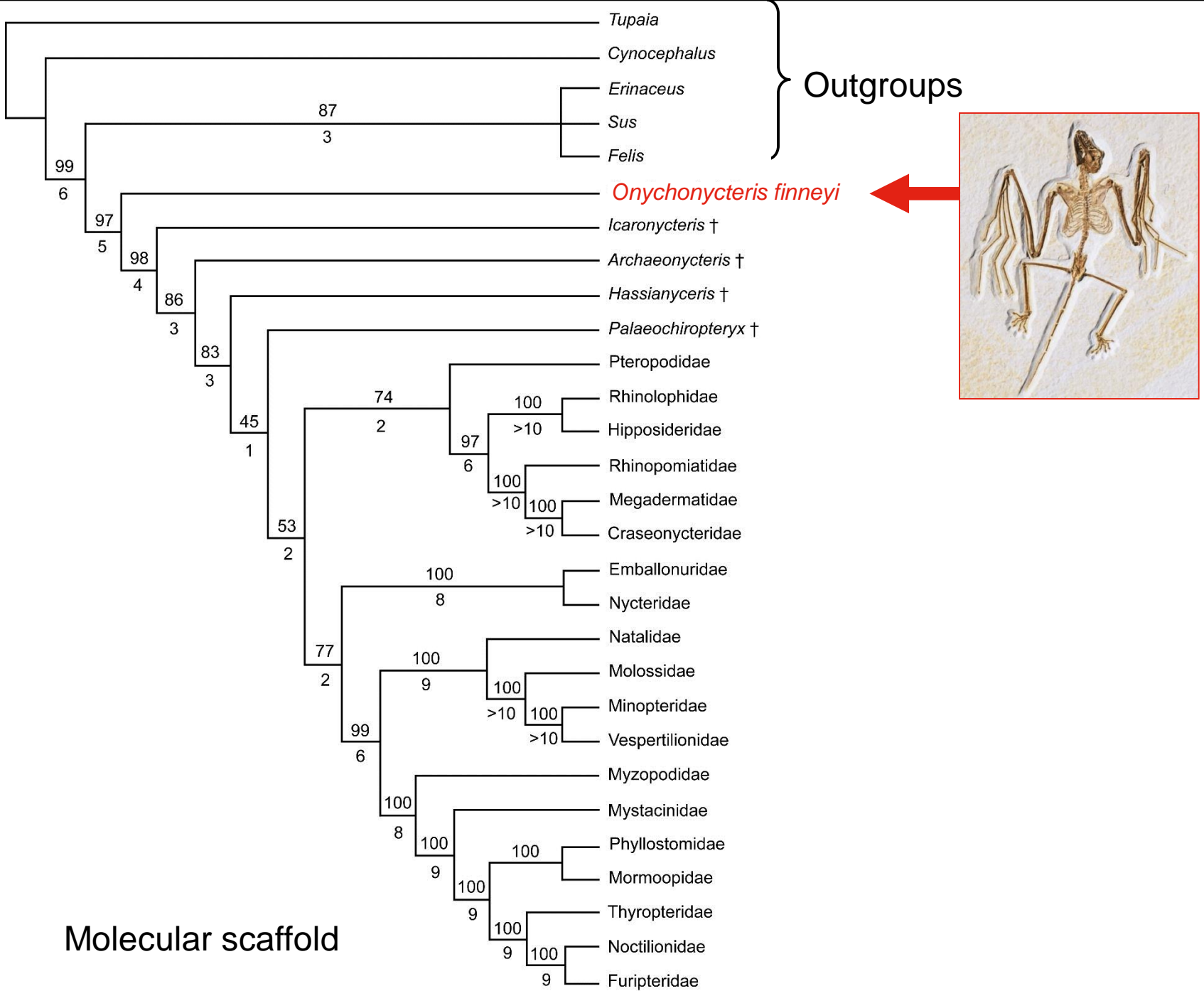
vědecký konsensus

neuměl echolokovat !!!

| <u>Taxon</u> | <u>Aspect Ratio Index</u> |
|------------------------------------|---------------------------|
| <i>Onychonycteris finneyi</i> | 1.74 |
| <i>Icaronycteris index</i> | 1.97 |
| <i>Archaeonycteris trigonodon</i> | 1.87 |
| <i>Palaeochiropteryx tupaiodon</i> | 2.04 |
| <i>Palaeochiropteryx spiegelii</i> | 2.06 |
| <i>Hassianycteris messelensis</i> | 2.51 |
| <i>Hassianycteris magna</i> | 2.66 |
| <i>Tachypteron franzeni</i> | 2.75 |
| Pteropodidae | 2.16-2.21 |
| Rhinopomatidae | 2.11 |
| Megadermatidae | 2.19 |
| Rhinolophidae | 2.14 |
| Emballonuridae | 2.39 |
| Nycteridae | 2.00 |
| Noctilionidae | 2.53 |
| Mormoopidae | 2.22 |
| Phyllostomidae | 1.99-2.20 |



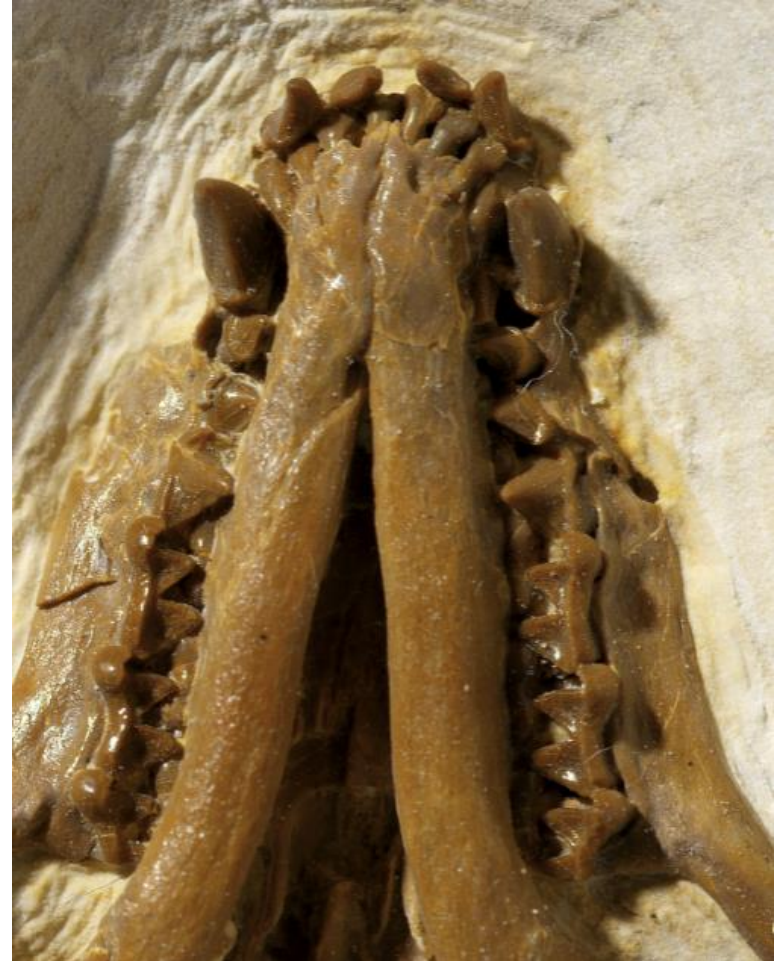




***Onychonycteris* Dentition**

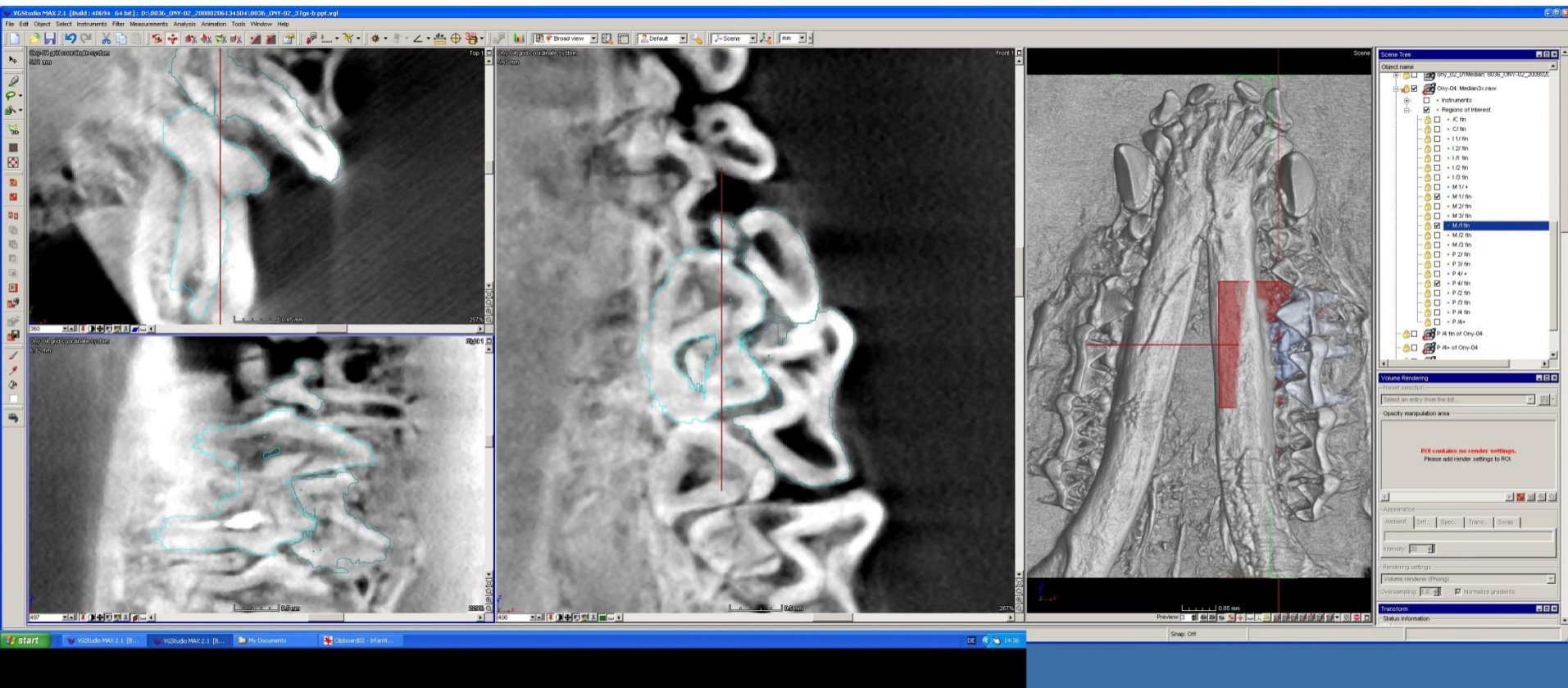


Paratype (Unaccessioned)



Holotype ROM 55351A)

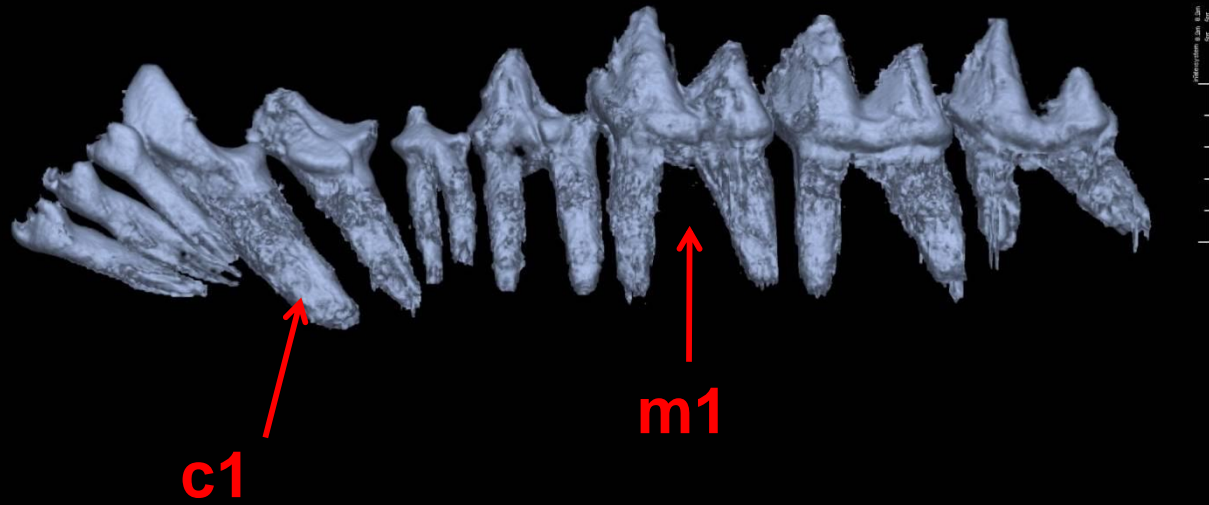
Onychonycteris Dentition





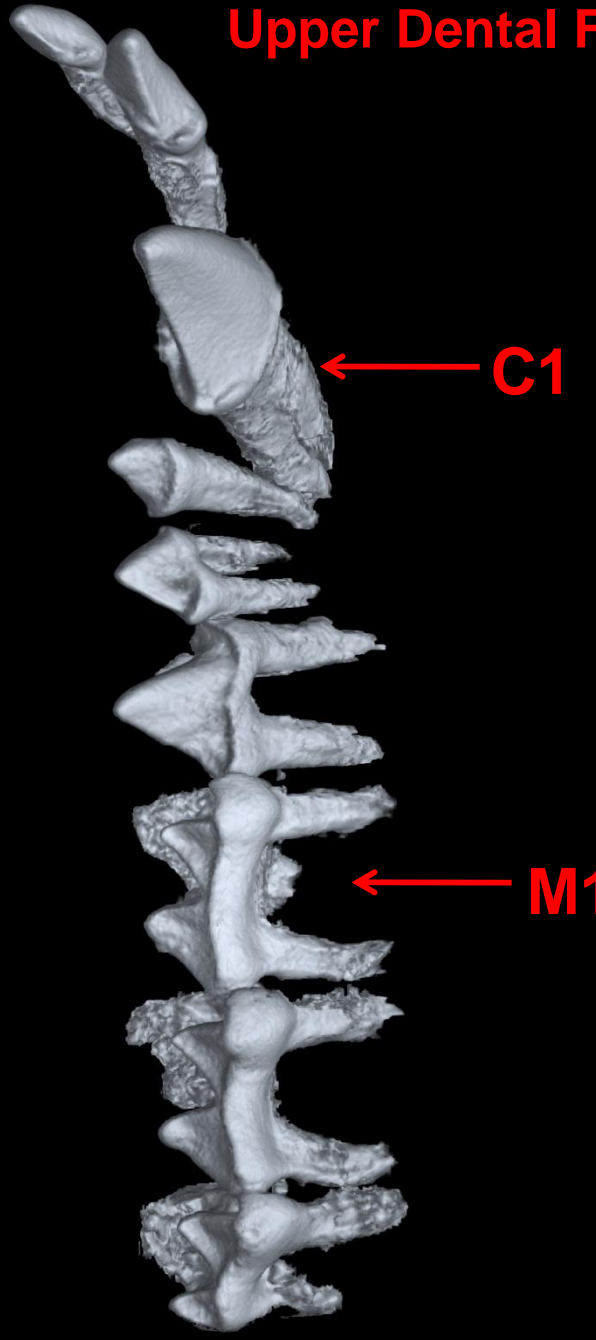
1.5 mm

Lower Dental Formula = 3.1.3.3

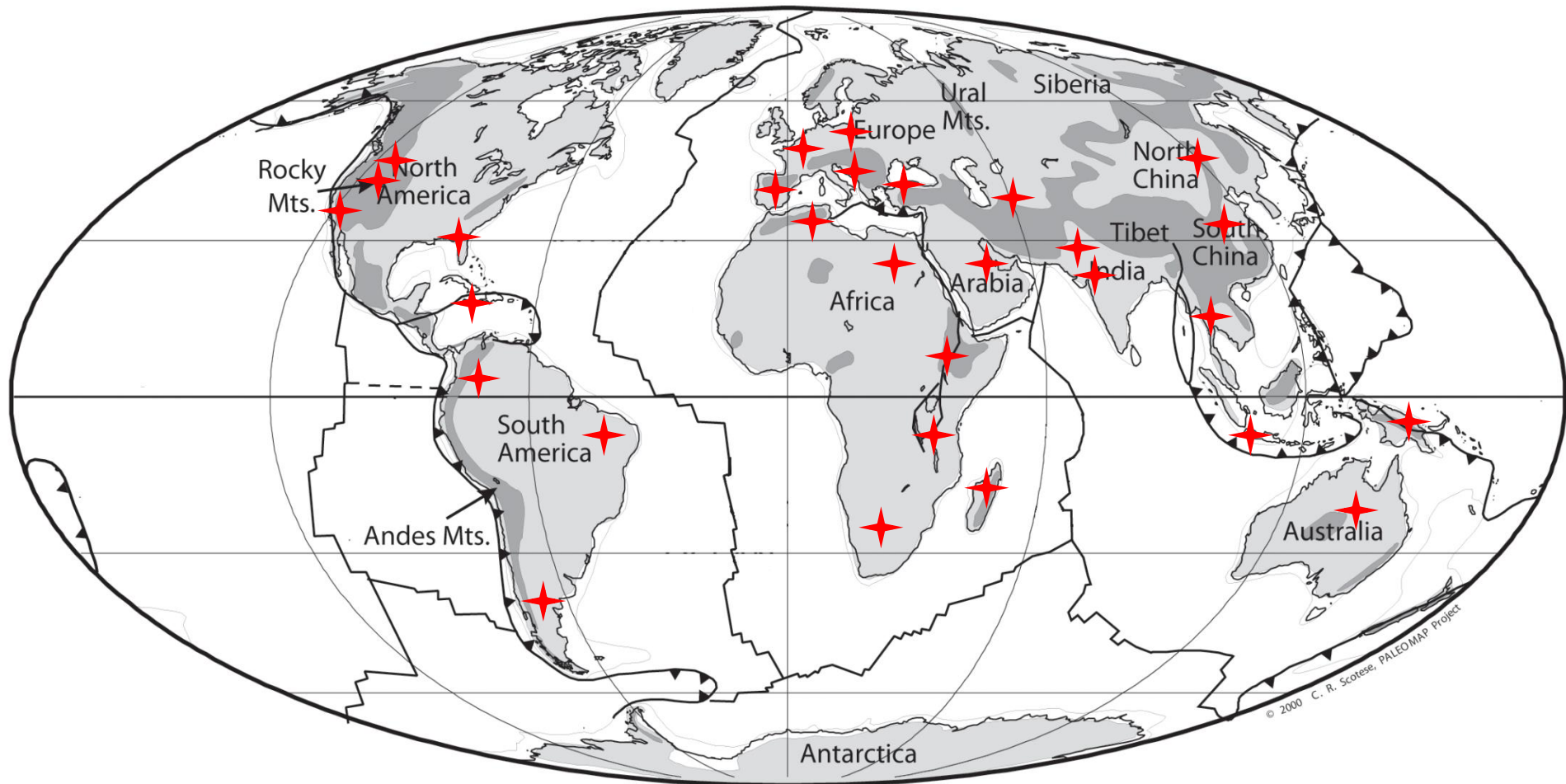


0.000000 0.000000 0.000000

Upper Dental Formula = 2.1.3.3



1.5 mm



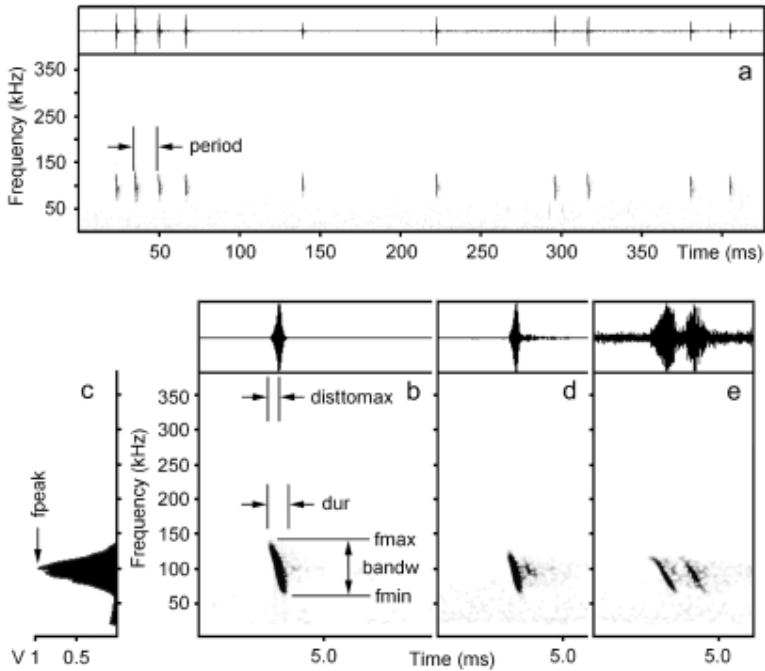


Figure 2 The waveforms, spectrograms and power spectrum (c) representing acoustic patterns and acoustic variables measured from the vocal pulses of *Typhlomys chapensis*. (a) Natural sequence of pulses, of which the first 4 comprise a typical bout; period, the period between pulses. (b) and (c) A pulse without echo; fmax, the maximum fundamental frequency; fmin, the minimum fundamental frequency; bandw, the pulse bandwidth; dur, the pulse duration; distomax, the duration to the pulse maximum amplitude; fpeak, the peak frequency. (d) A pulse with weak echo. (e) A pulse with strong echo.

A blind climber: The first evidence of ultrasonic echolocation in arboreal mammals

Aleksandra A. PANYUTINA,^{1,2} Alexander N. KUZNETSOV,² Ilya A. VOLODIN,^{2,3} Alexei V. ABRAMOV^{4,5} and Irina B. SOLDATOVA²

¹Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Moscow, Russia, ²Department of Vertebrate Zoology, Faculty of Biology, Lomonosov Moscow State University, Moscow, Russia, ³Scientific Research Department, Moscow Zoo, Moscow, Russia, ⁴Zoological Institute, Russian Academy of Sciences, Saint Petersburg, Russia and ⁵Joint Vietnam–Russian Tropical Research and Technological Centre, Hanoi, Vietnam

Figure 3 Eye structure in *Typhlomys chapensis*. (a) Section parallel to the optic axis stained according to Mallory represents extensive folding of retina. (b) Section through the optic axis stained according to Mallory at different magnifications: (b1) general eye composition, (b2) close-up view of the retina and (b3) close-up view of the retinal fold. (c) Longitudinal section of the optic nerve at its exit out of retina stained with hematoxylin-eosin shows gliosis of the optic nerve. AC, anterior chamber; Ch, choroid; Co, cornea; GCL, ganglion cell layer; I, iris; INL, inner nuclear layer; L, lens; NFL, nerve fiber layer; ON, optic nerve; ONL, outer nuclear layer (rod nuclei); P, pigment epithelium; R, retina; S, sclera. Scale bars 0.1 mm.

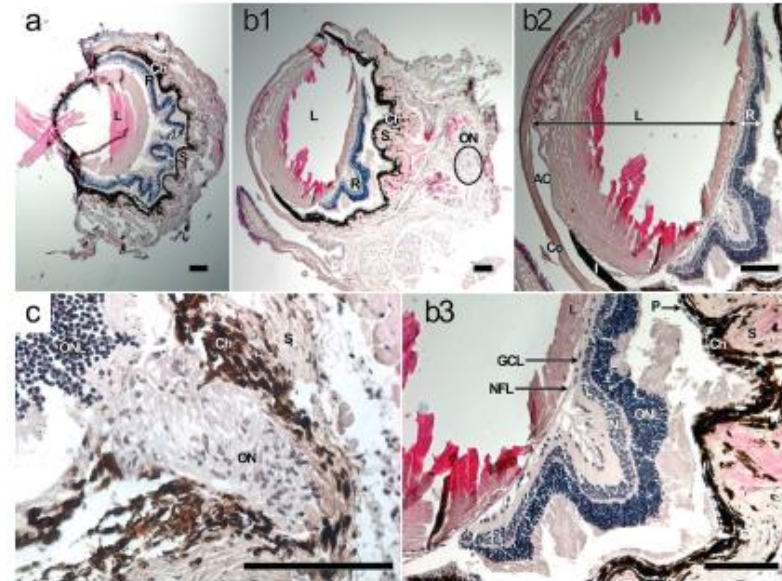


Figure 1 Vietnamese pygmy dormouse *Typhlomys chapensis*. Its reduced eyes are reflected in the generic name, which means “the blind mouse.”

Létání: omezení tělesné velikosti

Letouni: 1.9 g - 1.5 kg

Ptáci: 1.5 g - 16 kg **Hmyz: 0.01 -200 g**

Pterosauři 4 g - 100 kg



Pteropus vampyrus

... netopýr velikosti člověka



Chiroptera – nejmenší genom mezi savci

- 1.63 pg in *Lophostoma carrikeri* to 3.17 pg in *Rhinopoma hardwickii*, averaging $2.35 \text{ pg} \pm 0.02\text{SE}$.
- Pteropodidae: variabilita velikosti genomu výrazně omezena

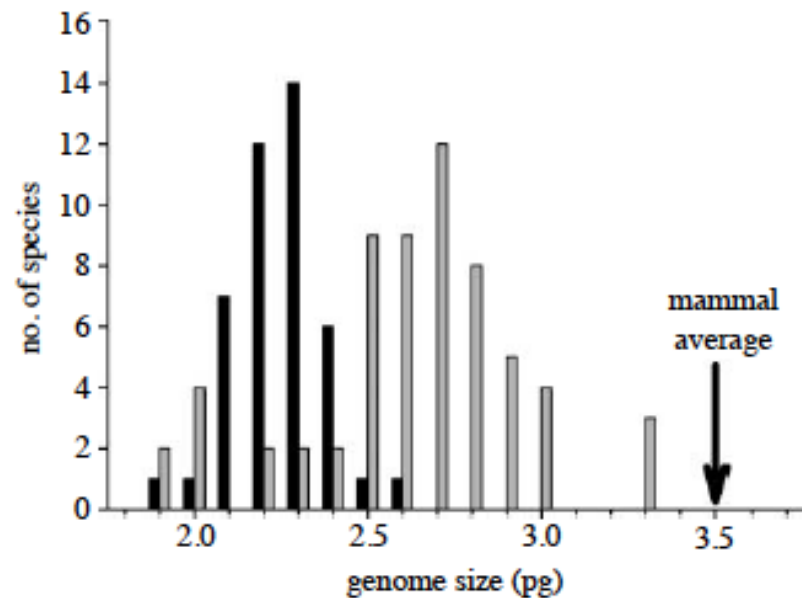


Figure 1. Summary of genome size diversity in 43 species of megabats of the family Pteropodidae (black bars, present study) and 62 species from six families of microbats (grey bars, Gregory 2009).

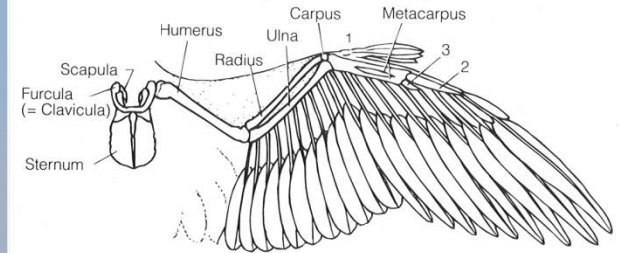
Letouni jsou výlučně noční

m.j. i z energetických důvodů:



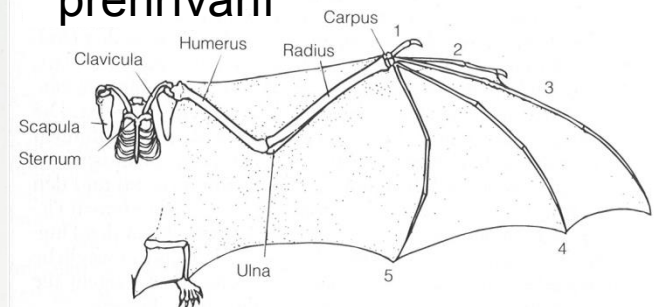
<http://www.birdforum.net/opus/images/>

Peří – izolace proti přehřívání



<http://www.dlimages.com/discover/previews/976/35/02109.JPG>

Velká plocha neizolovaného povrchu – riziko denního přehřívání



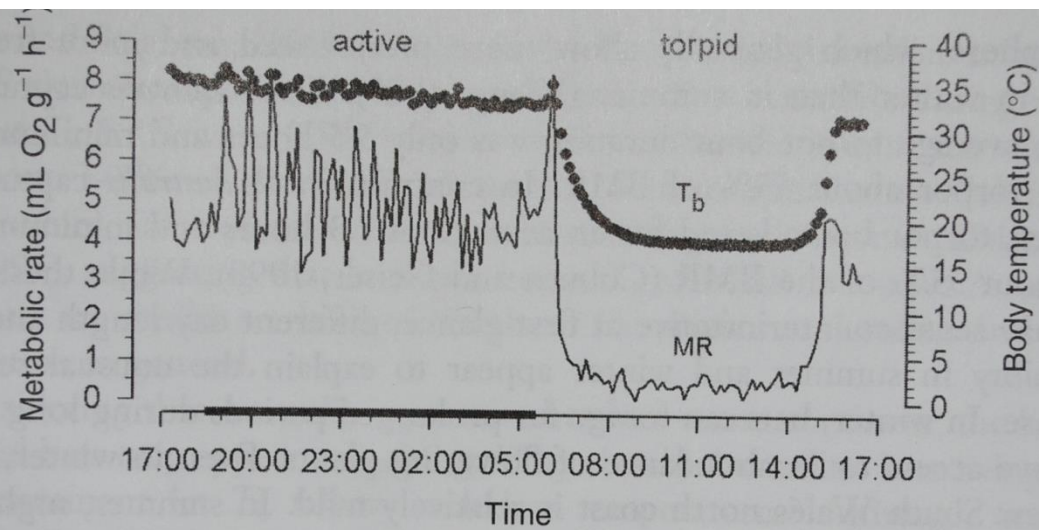
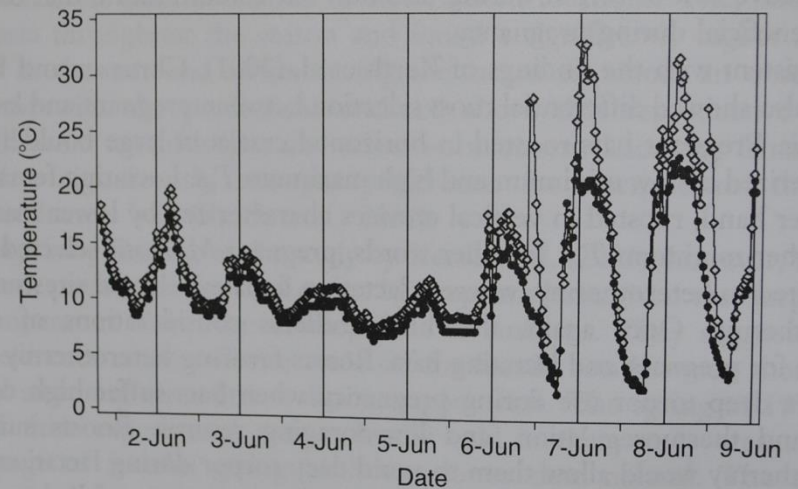
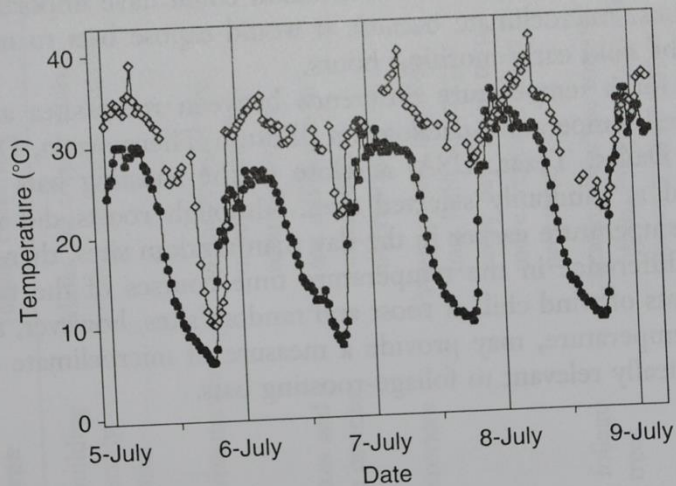


Figure 1.3 Daily fluctuations of body temperature (T_b , broken line) and metabolic rate (MR, continuous line) of a common blossom-bat, *Syconycteris australis*. Torpor entry occurred after lights on in the morning and spontaneous arousal in the afternoon.

Heterotermie, denní strnulost, hibernace



časoprostoprová paměť

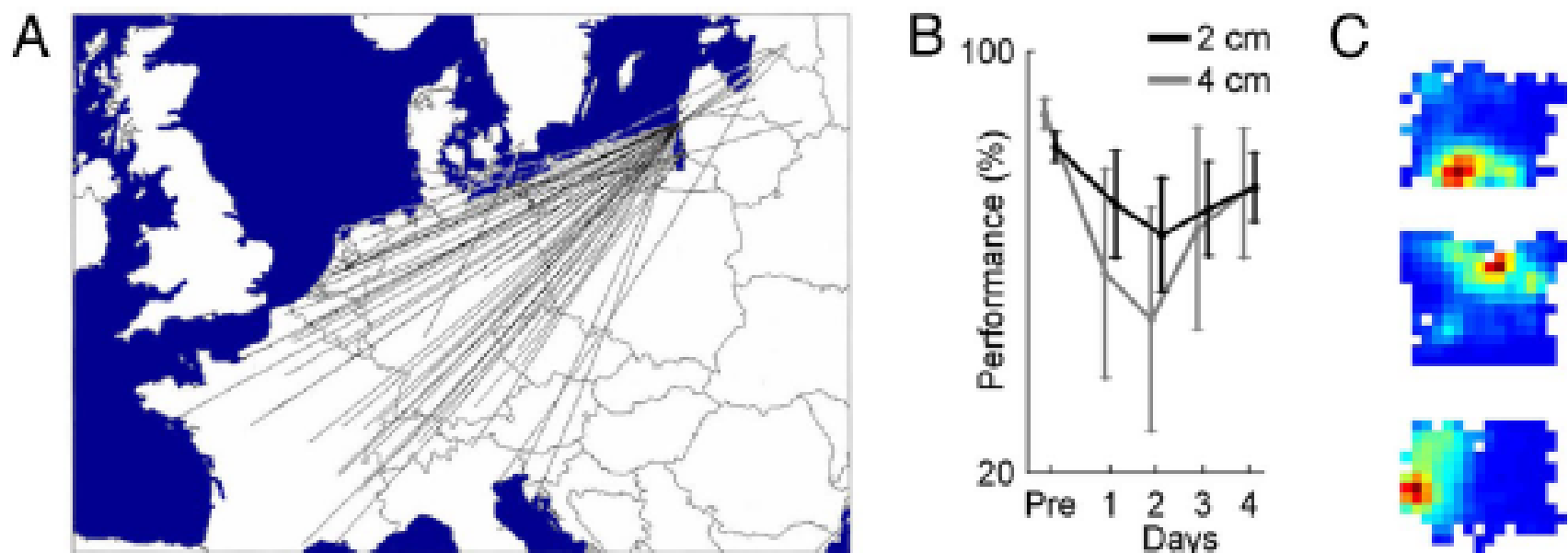


Fig. 5. Spatial memory and navigation in echolocating bats. (A) Example of long-range migration by the bat *P. nathusii*. Straight lines correspond to individual bats that were banded in Eastern Europe and then recaptured as far as Croatia, Italy, and France (adapted with permission from ref. 54). (B) Spatial memory for 3D flight paths, on the centimeter scale: echolocating bats (*M. lyra*) were trained to fly through an array of wires, and two bats flew through the wires without touching them on >85% of trials ("pre"); when the wires were moved by 4 or even 2 cm, the bats showed a significant drop in performance on days 1–2, followed by slow recovery. Data were measured from ref. 100 and reanalyzed. Error bars, mean \pm SEM, computed over all wire-shift trials in these two bats. (C) Place fields of three "place cells," recorded from the hippocampus of big brown bats, a small bat species weighing \sim 15 g, as the animal was crawling in a rectangular arena (103). Blue color, no spiking activity; red, maximum activity of the neuron (data recorded by N.U.).