



# Bats in epidemiology

## Between hopes and fears

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**Who are bats ?**



**How to see them ?**

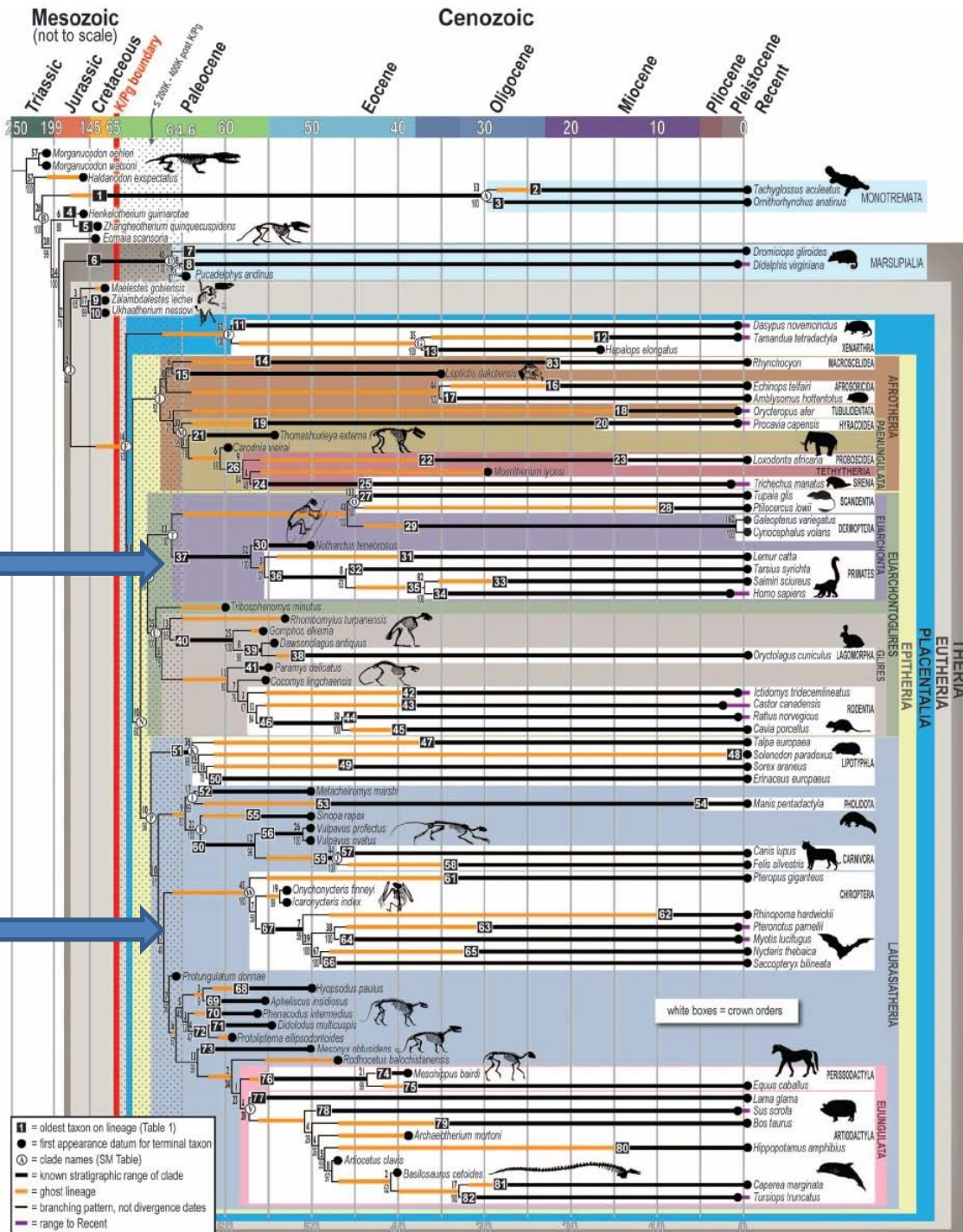
# QUESTIONS

- Today bats are more and more associated with EID, why ?
- **What are the links between their genetic diversity, their ecological variability, their behaviours, and epidemiology of EID ?**
- Who are bats ?
- **« Between hopes and fears » or « from fears to hopes » ? With 3 questions .....**



# 1 - ARE BATS SPECIAL ?

- Chiroptera natural history
- **Colonies of up to 1 million individuals**
- Long life span : a 20g bat can live 30 years
- **Low reproductivity**
- Flying capacities, migrations and movements
- **Social organisation within - between species**
- Immunological data ? What do we know about bat immune system ?



**Mammalian orders origin**  
 Science, 08 Feb. 2013



# CHIROPTERA TODAY

1116 species (last global review, 2005)

Altogether, 18 families and 202 genera

**Nearly worldwide, continents, islands and archipelagos**

Weight : 2g to 1.5kg. Wingspan : 15cm to 1.5m

Ecology, ethology, very diverse

**Food habits unique among mammals**

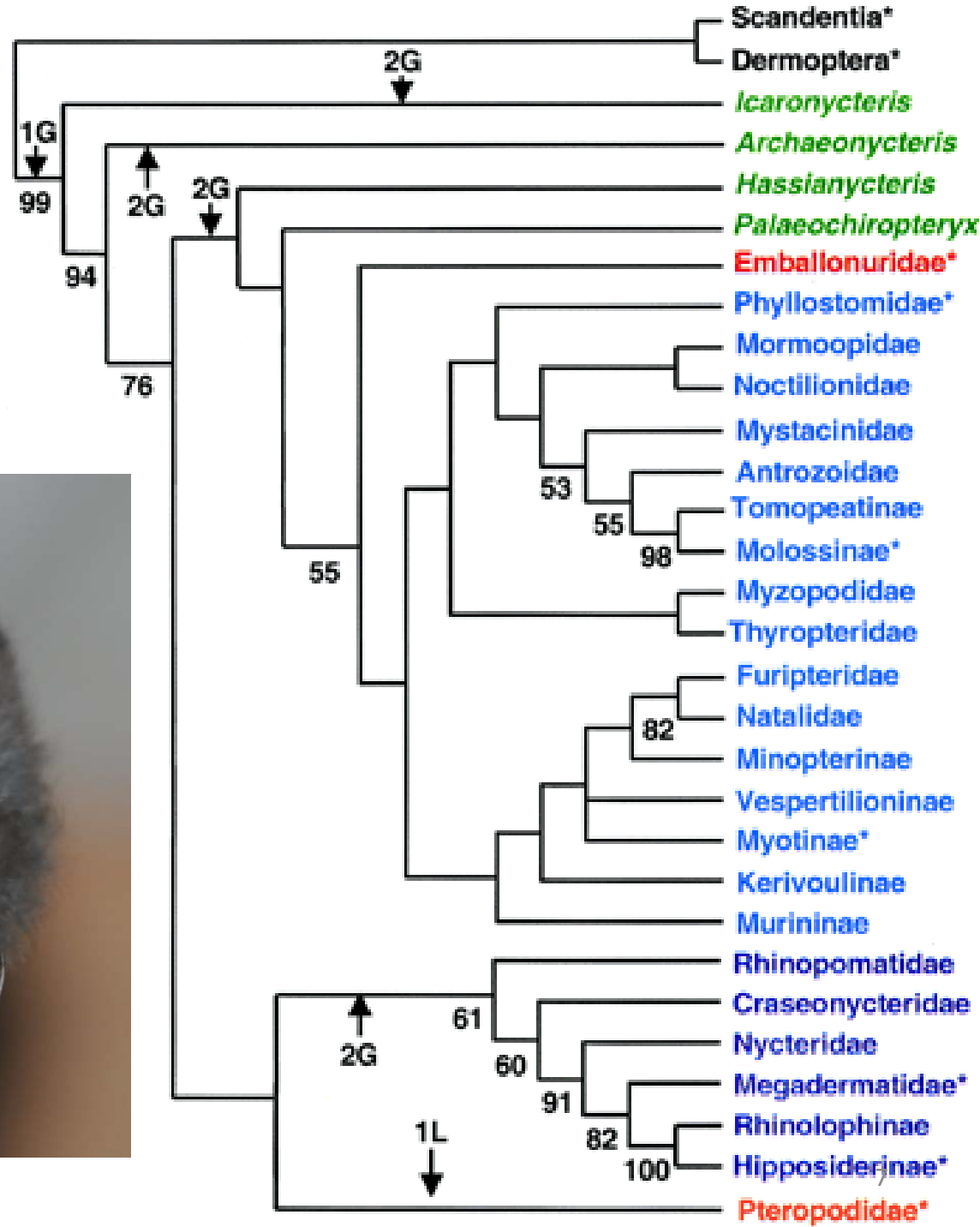
**Echolocation (sonar) in many species**



Megachiroptera  
Microchiroptera

Changed into

Yinpterochiroptera and  
Yangochiroptera







**Bat biodiversity**

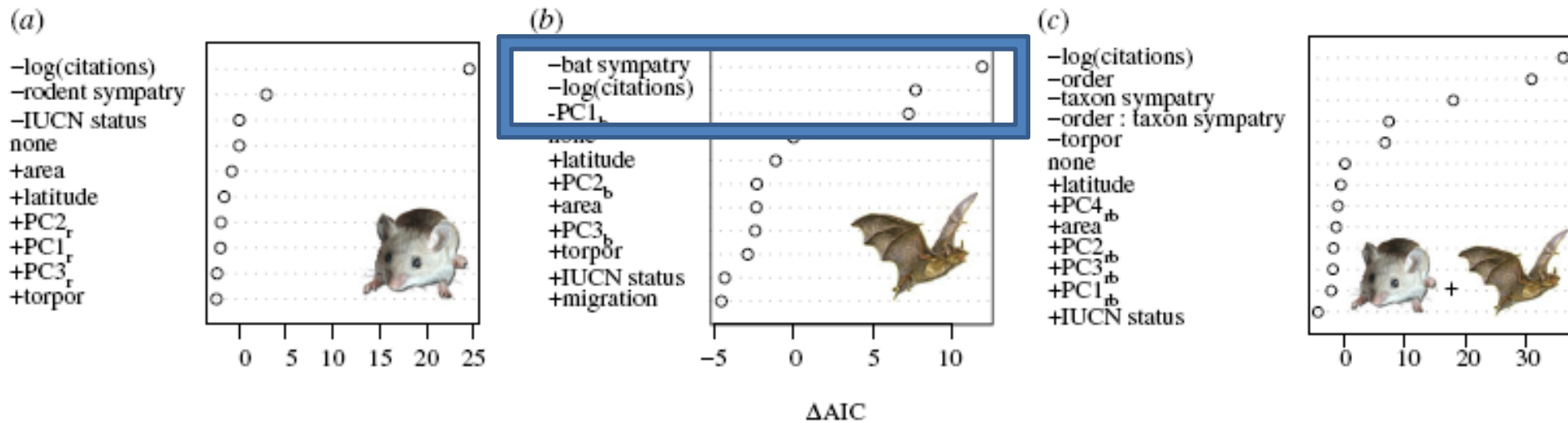




Colonies sometimes very crowded. Epidemiological and immunological implications ?



# « A comparison of bats and rodents as reservoirs of zoonotic viruses : are bats special ? »

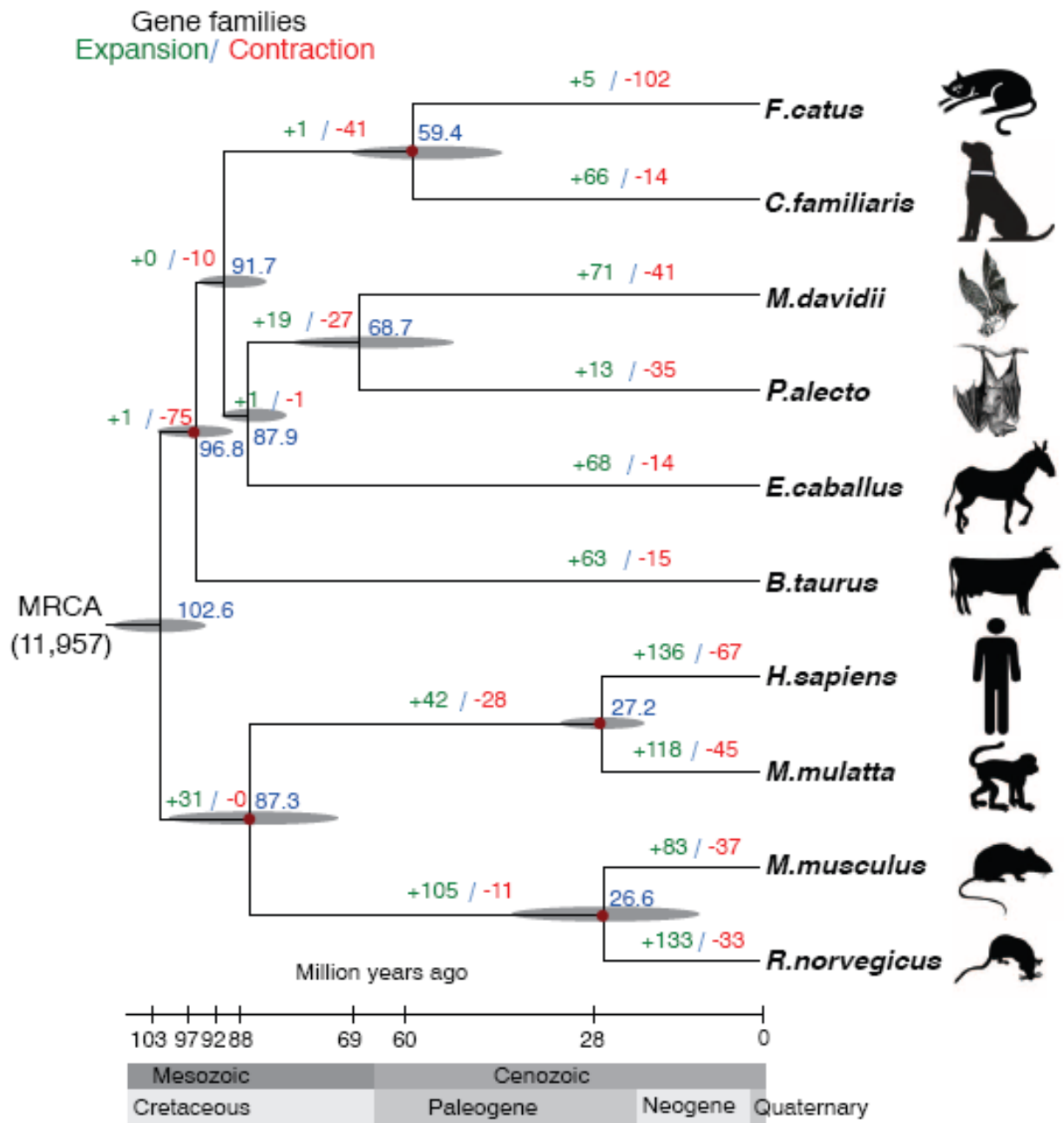


**Bat sympatry**  
**Number of virus / Citations**  
**Reproduction data**

*Proceedings of the Royal Society B (2013)*







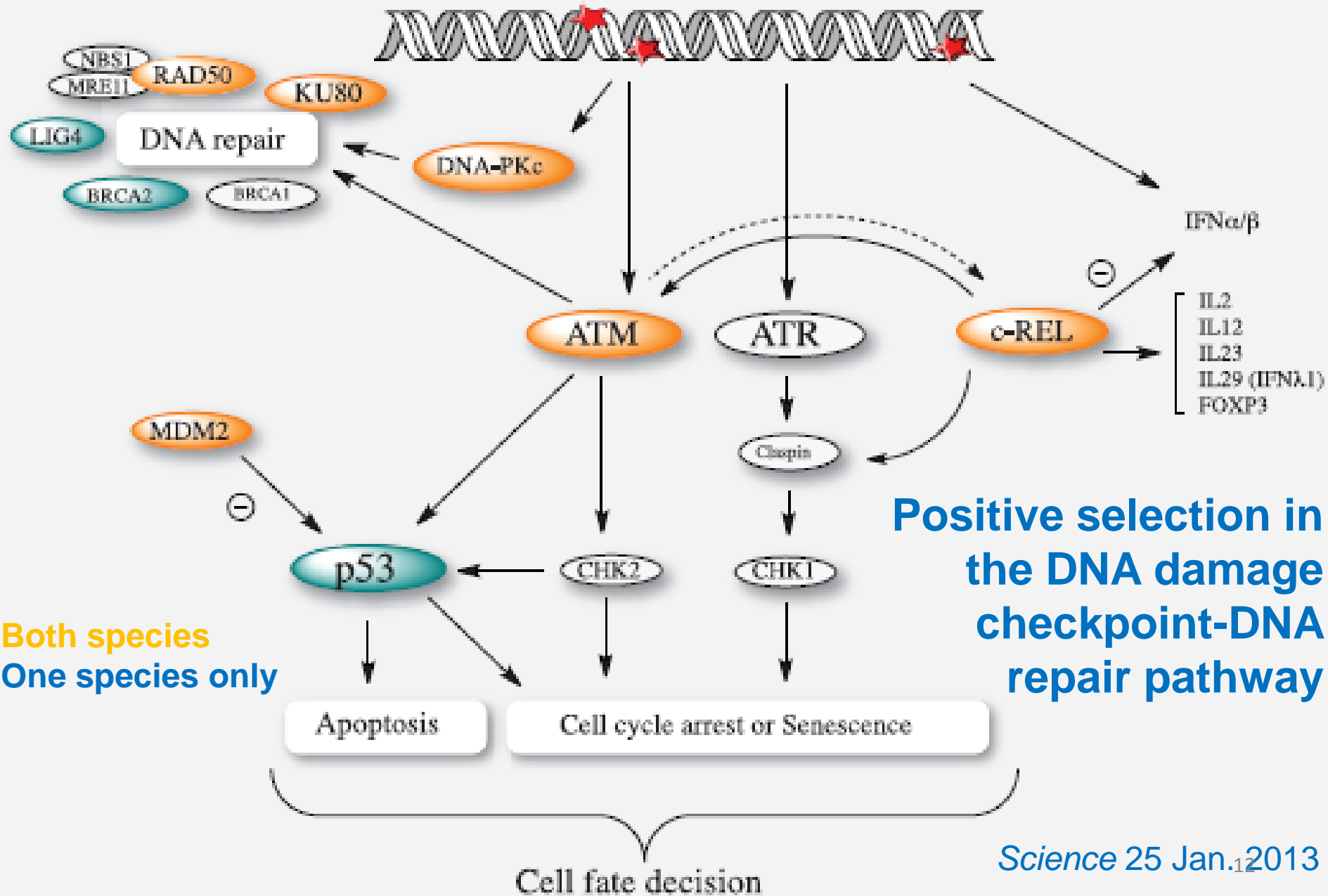
« Comparative analysis of bat genomes provides insight into the evolution of flight and immunity »

Fig. 2. Phylogenomic analysis. Maximum-likelihood phylogenomic analysis of 2492 genes from *M. davidii*, *P. alecto*, and eight mammalian species. Divergence time estimates in blue, gene family expansion events in green, and gene family contraction events in red. MRCA, most recent common ancestor.



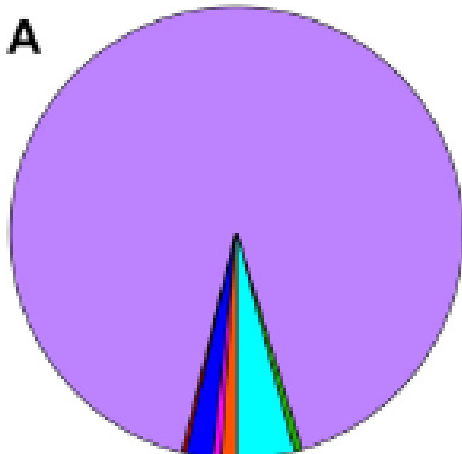
**A**

DNA damage

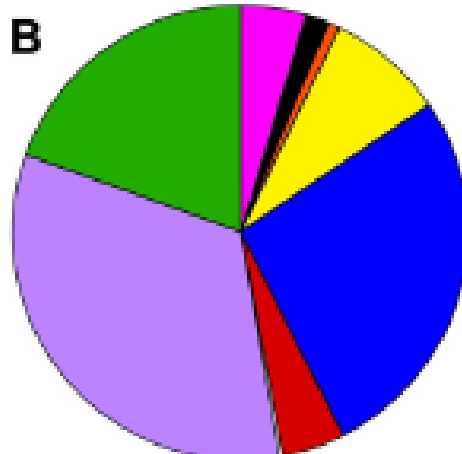


## 2 - ARE VIROLOGISTS SPECIAL ?

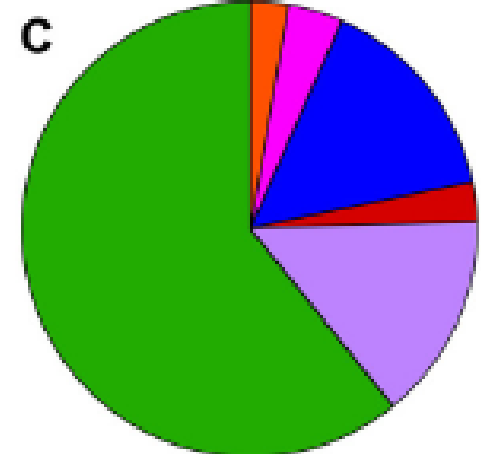
- Recent increase of publications dealing with bat virus
- **Looking for the « virome » of a few species**
- Next generation sequencing, new tools, metagenomics, new data
- How to interpret properly?
- **Will we be able to anticipate next viral zoonosis ??**



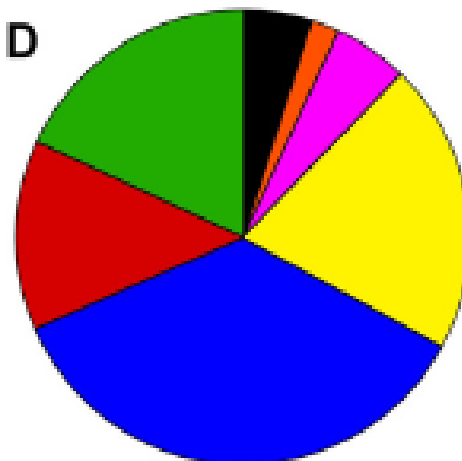
**A**  
Big brown - juvenile female - fecal



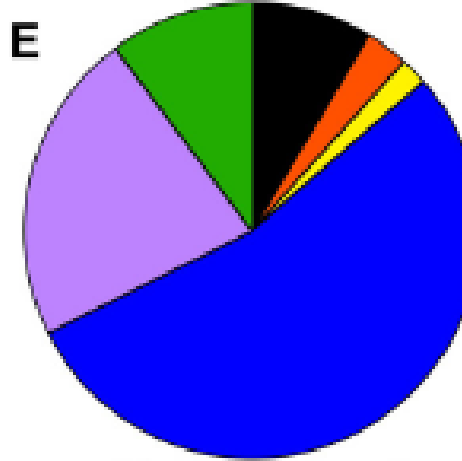
**B**  
Big brown - adult male - fecal



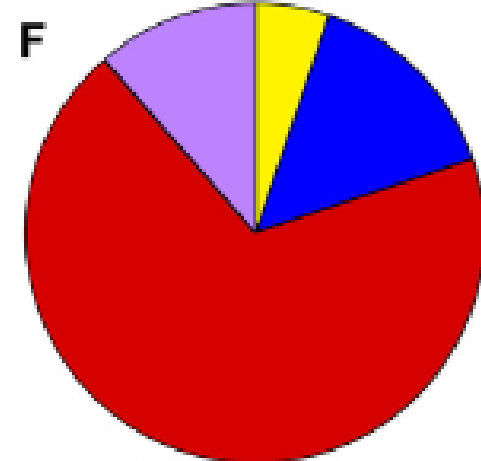
**C**  
Big brown - juvenile male - fecal



**D**  
Little brown - mix mix - fecal



**E**  
Tri-colored - juvenile male - fecal



**F**  
Big brown - juvenile female - oral



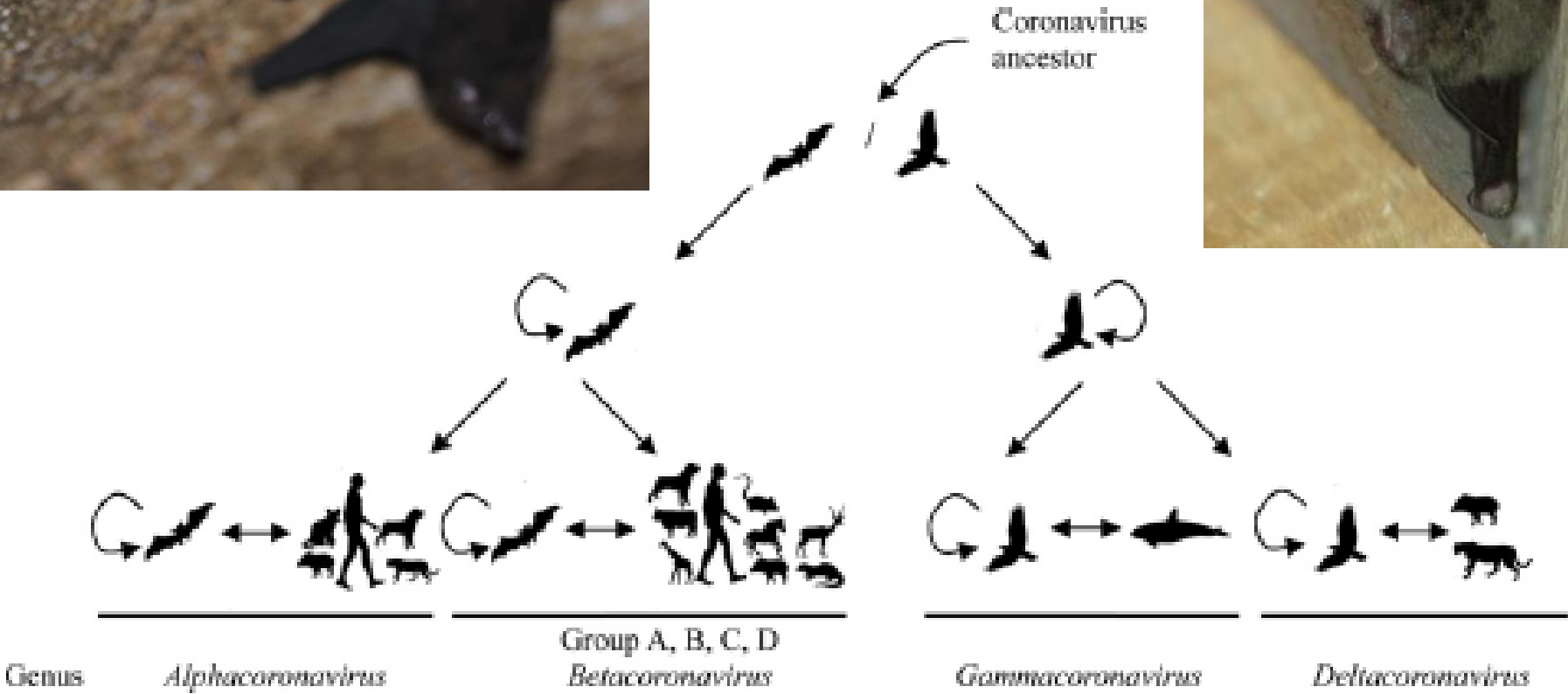


# BATS & VIRUSES

- **Lyssavirus**, rabies, Lagos, **Duvenhage**, **EBL1**, **EBL2**, **ABL**, etc. (worldwide)
- **Coronavirus**,  $\alpha$ CoV,  $\beta$ CoV (China, Middle-East)
- **Filovirus**, **Ebola**, **Marburg** (Africa)
- **Influenzavirus** (Kazakhstan, Guatemala)
- **Paramyxoviridae** (worldwide)
- **Rubulavirus**, Menangle (Australia)
- **Henipavirus**, **Nipah** (Asia), **Hendra** (Australia)

# Bats & Coronavirus

## Coronavirus & Bats





Bats reservoir of many viruses but apparently not always susceptible to the diseases

What about transmission, between bats and from bats ?

Bat viruses may be different from viruses found in non flying mammals (SARS / « SARS-like »)



**Many recently known examples but the situations does not seen new**

**If bats can live in contact with these viruses, could they be used to understand this kind of harmless relationship ?**



# Bat point of view ?

Bat protected in many (but not all) countries

Bat conservation international  
[www.bat.con.org](http://www.bat.con.org)

Bat populations declining worldwide because of insecticides and deforestation

White nose syndrome in North America (>5M +) associated with *Geomyces destructans*, present in Europe but with no known impact



*Pteropus  
subniger,*  
extinct

20%  
of the  
species  
are  
considered  
as  
threatened







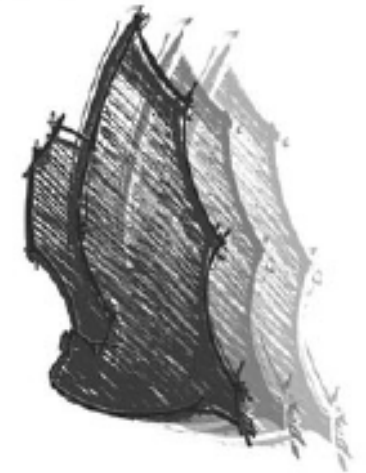
Vincent van Gogh, 1885

# UNEP/EUROBATS

## Agreement on the Conservation of Populations of European Bats

<http://www.eurobats.org/>

### 3 - Are batworkers special ?



EUROBATS

The 17th International Bat Night will take place on the 24-25 August 2013



# CONCLUSION

- **Bats are of interest for batworkers, epidemiologists, virologists and molecular biologists, but not only**
- Coevolution studies linking virus and bats should bring a lot of data
- **Model in the field of epistemology, biology, medicine, epidemiology, zoology, evolution**
- Bats point of view not to be forgotten





Merci pour  
votre  
attention