

# Using natural history collections in ecological research: detecting the effects of landscape and climate change in bat populations.



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## Background

Three theories can be used to predict body size change in mammals:

### Bergmann's rule (1):

- Reduction in body size due to climate change

### Island Rule (2):

- Increased body size of small mammals due to habitat fragmentation.

### Resource Rule (3):

- Increased body size due to high food supply



Do any of these rules apply to bats?

Bat species have adapted wing morphology according to their habitat preferences:

### Mobile species:

- Small surfaced, narrow wings
- Fly fast, long distances
- Hunt in open or edge habitats



e.g. *Nyctalus noctula* or *Eptesicus nilssonii*

### Less mobile species:

- Large surfaced, broad wings
- Fly slowly but more manoeuvrable
- Hunt in closed habitats



e.g. *Myotis* spp. or *Plecotus auritus*

Have wings adapted to landscape change?

## What we know so far

- Resource rule shown when *Pipistrellus kuhlii* crania increased in size due to street lighting increasing prey items (4).
- Rapid morphological change in bird wings and crania due to climate and landscape changes has been shown (5, 6, 7).

Though these studies use time as a proxy for climate and landscape change.

## Research questions

1. Does body size in bats change according to Bergmann's, Island or Resource rules?
2. Is bat wing morphology adapting due to changes in open or closed habitat?

## Methods

- Over 500 Swedish museum specimens were measured.
- Three species: *Eptesicus nilssonii*, *Pipistrellus pygmaeus* and *Plecotus auritus* were measured.
- Specimens date from 1835 to 2016.
- Cranial and wing measurements were taken (Figure 1).

- Empirical landscape and climate change data used.
- Historic maps from late 19<sup>th</sup> C, & early 20<sup>th</sup> C digitised (Figure 2; see Poster by Auffret, A., BES, 2016).
- Climate data may include: European Climate Assessment & Dataset project (8), high resolution climatic topographic maps (9), Swedish climate data (10).

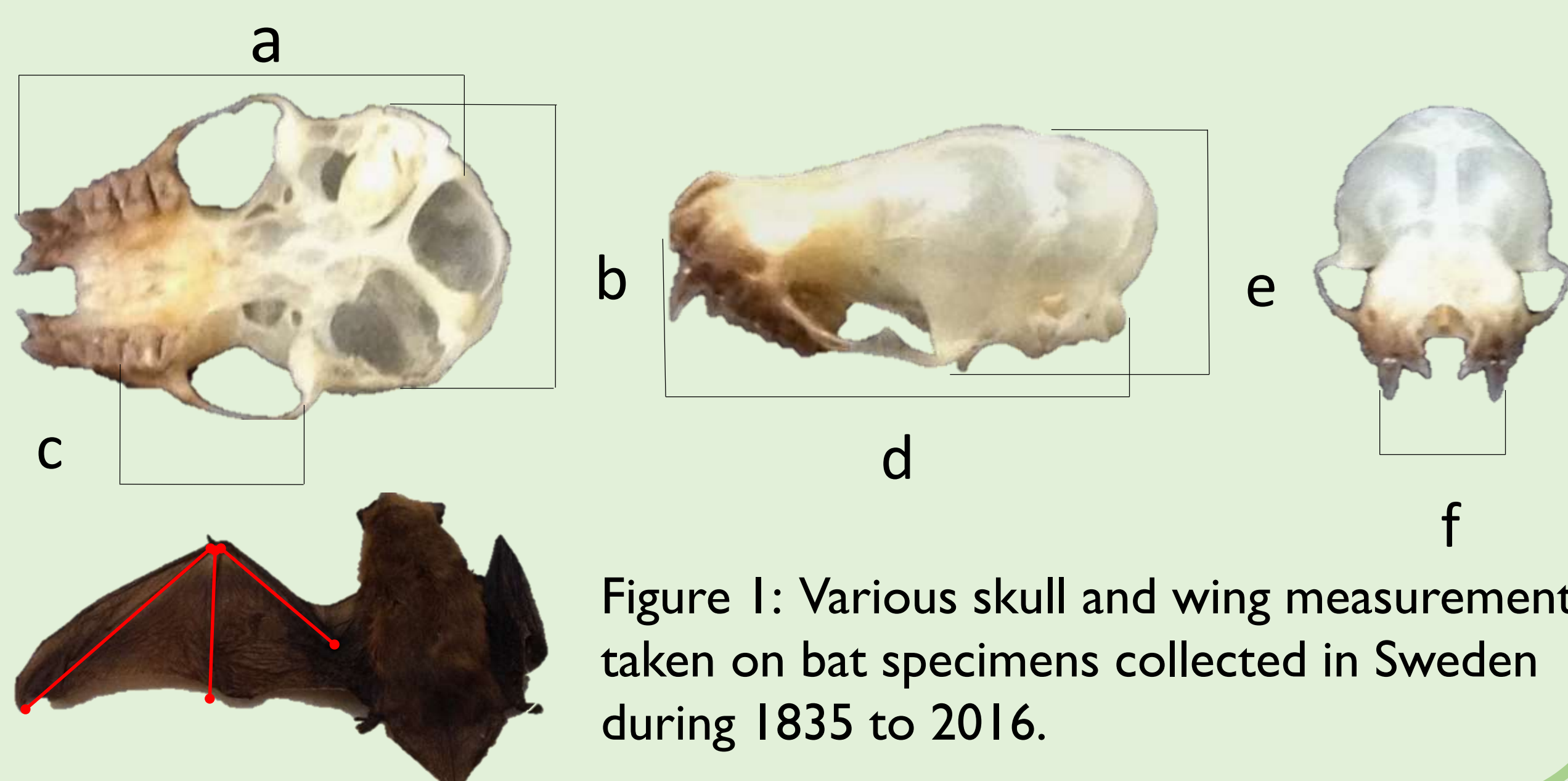


Figure 1: Various skull and wing measurements taken on bat specimens collected in Sweden during 1835 to 2016.



Figure 2: (a) Old Cadastral maps dating from late 19<sup>th</sup> C in Sweden (b) Economic maps from early 20<sup>th</sup> C in Sweden. © Lantmäteriet.

## Acknowledgements:

Thanks to all the collection staff at the Swedish Museum of Natural History, Uppsala Evolution Museum, Gothenburg Natural History Museum and Lund Biological Museum for their enthusiasm and help.

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