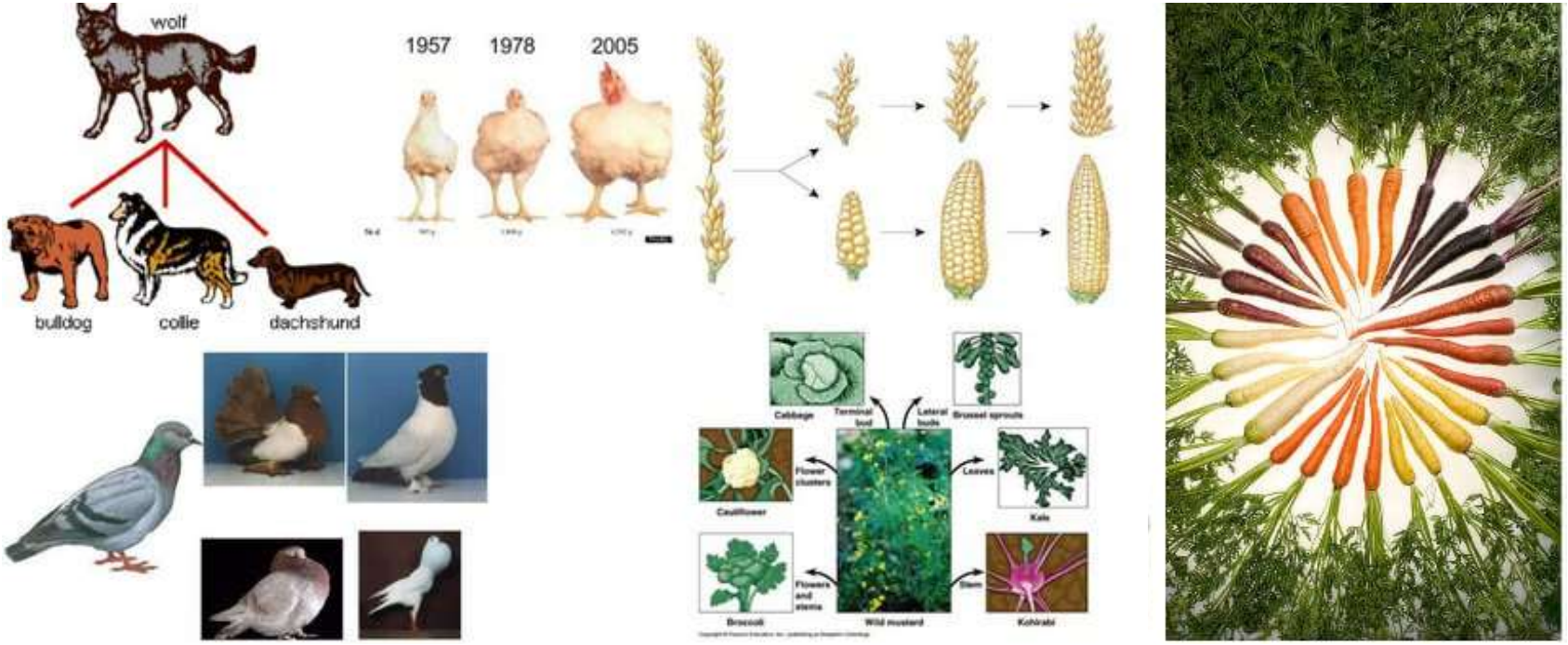
Zoogeography

Lesson 3

Artificial selection

is the process by which humans choose individual organisms with certain phenotypic trait values for breeding

- Darwin's studies supported animal breeders in being able to modify the anatomical and behavioural characteristics of dogs and pigeons providing a neat parallel to what he believed had happened in nature over long periods of time.



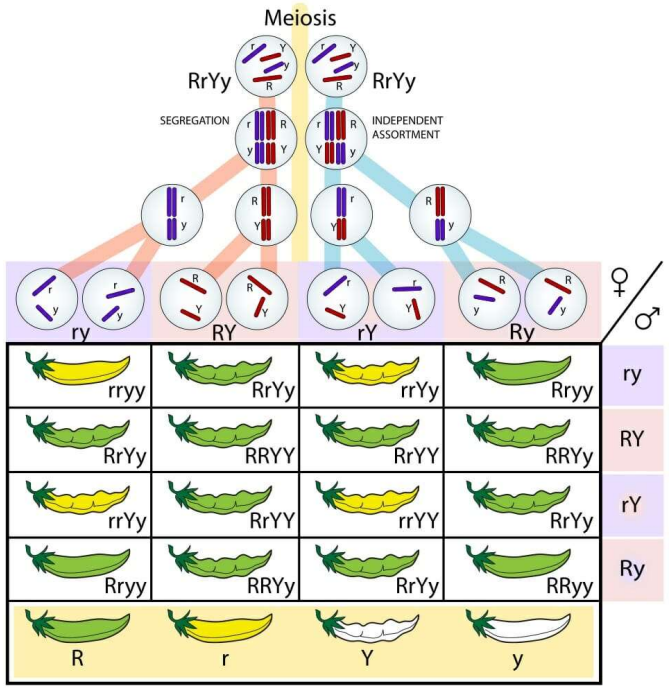
Main issues to Darwin's theory

- all these different breeds of dog or pigeon were still able to breed with one another, which did not support Darwin's suggestion that this was the way in which new species could appear.
- Nor could Darwin provide any explanation of **how precisely the different characteristics were controlled** and passed from generation to generation.
- most people believed that the **Earth** was only a **few thousand years old**.

1866 Gregor Mendel

Genes come in pairs and are inherited as distinct units, one from each parent.

work remained unnoticed until the beginning of 1900



Driving mechanism of evolution: **Natural selection**

Credit: Reddit

- **Any pair of animals or plants produces far more offspring than would be needed simply to replace that pair**
- There must be competition for survival among the offspring
- Furthermore, these offspring are not identical to one another

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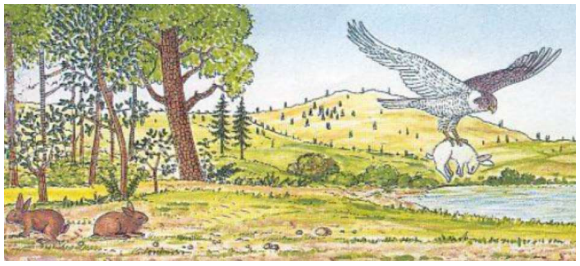
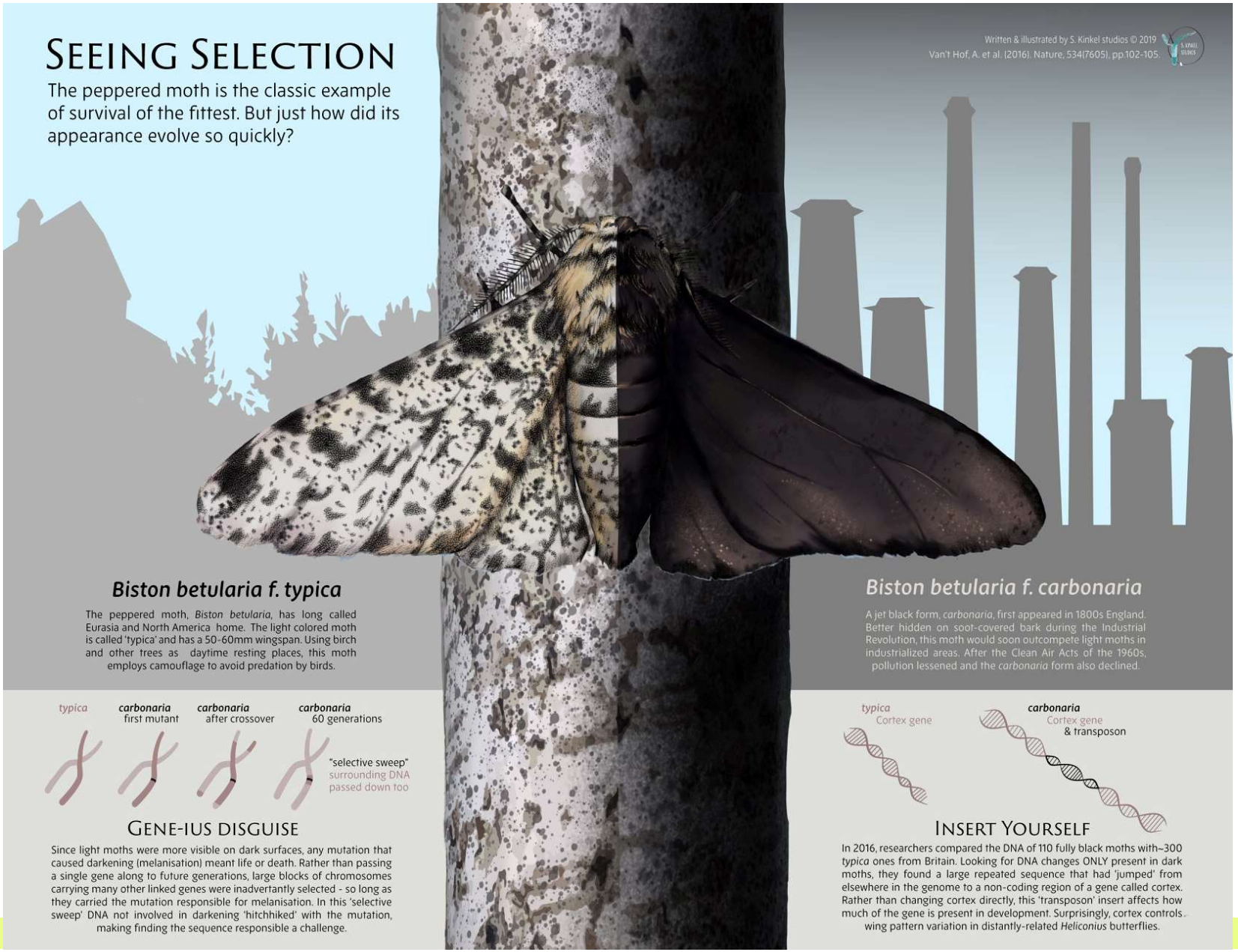
some these variations will prove to be better suited to the mode of life of the organisms than others.

The offspring that have these **favourable characteristics** will then have a natural advantage in the competition of life and will **tend to survive** at the expense of their less fortunate relatives.



- Early 1800: dark pepper moths were 2%
- By 1895: dark pepper moths were 95% of the population



Bio(zoo)geography Today

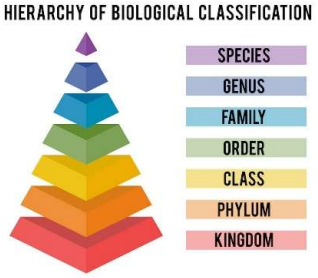
- Ecologists began with the study of **living species** or subspecies, and with the factors that control, or alter, their patterns of distribution today.

- This was because they were working at a scale of detail, both in geographical terms and in taxonomic terms, that could not be perceived in the historical record.

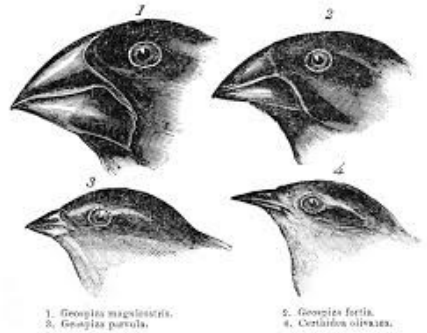
- Only in the study of the comparatively **recent past**, such as the **Ice Ages**, could the **biogeographer** be **confident of the ecological preferences of the organisms under study**, because they were closely related to those alive today.
  - Fossil sufficiently detailed for taxonomy
  - Environmental changes sufficiently detailed

Taxonomy

- Science of classifying organisms → most ancient of biological disciplines
- 1953: discovery of DNA structure→ determination of features of form and physiology
- Species can be grouped
- structural features alone have proved misleading, and taxonomists rely increasingly on genetic studies to understand relationships in the natural world.



- Species: most are clearly defined by their (common):
  - Appereance
  - Structure
  - Physiology
  - Behaviour



+Great deal of variation within species:

Size,

Colour,

Feeding preferences

Mate choice

Species normally restrict their breeding to individuals of the same species, but this is not always the case, and one cannot define a species on this basis.

Hybridization

Organisms that have intermediate characteristics.

Mule

Hinny

Hebras

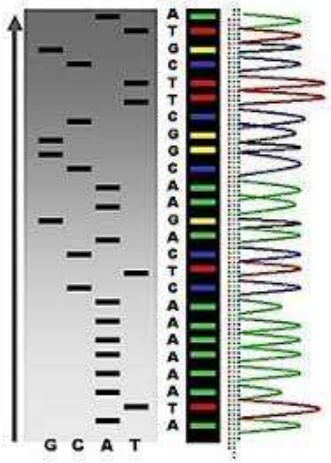
Zorse

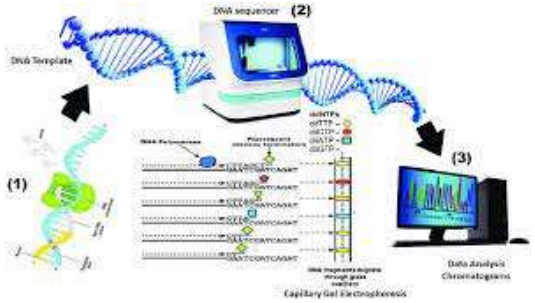
Zonkey

	Horse ♀	**Donkey** ♀	**Zebra** ♀
Horse ♂	Horse (*E. ferus*)	Hinny	Many terms incl. "hebra"
Donkey ♂	Mule	Donkey (*E. africanus*)	Many terms incl. "donkra"
Zebra ♂	Many terms incl. "zorse"	Many terms incl. "zonkey"	Zebra (3 species)

- The development of techniques of analysis of the details of the **molecular structure** of their genes provided an enormous quantity of data on the molecular characteristics of the organisms.

- At the same time, as it became **easier and cheaper to obtain this data**, the number of organisms whose molecular characteristics had been analysed rapidly increased



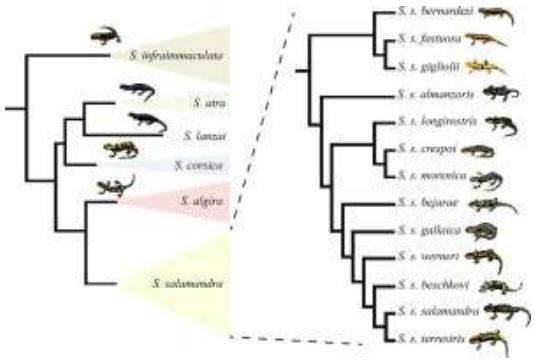


Species and subspecies

- Some species, for example, exist in a number of different forms that are sufficiently stable to be termed **subspecies** → often have different distribution patterns (termed **polytypic species**).

- less variable species that exists in just one form – called a **monotypic species**.

- Increasing use of genetic analyses highlights the complex relationships within species, and such complexity is reflected in distribution patterns.



i.e. Herring gull (*Larus argentatus*)

- Example of polytypic species, 12 subspecies spread around the entire Northern Hemisphere.
- Genetic studies revealed a complex relationships among subspecies

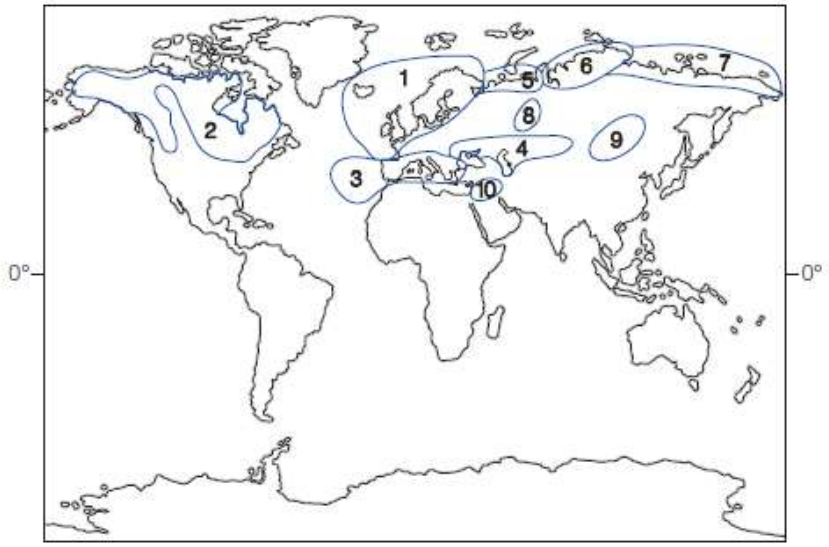


Figure 2.1 Approximate breeding distributions of various taxa within the herring gull complex [2,3]: (1) European herring gull (*Larus argentatus*); (2) American herring gull (*L. smithsonianus*); (3) yellow-legged gull (*L. michahellis*); (4) Caspian gull (*L. cachinnans*); (5) Heuglin's gull (*L. heuglini*); (6) Taymyr gull (*L. taimyrensis*); (7) Vega gull (*L. vegae*); (8) steppe gull (*L. barabensis*); (9) Mongolian gull (*L. mongolicus*); (10) Armenian gull (*L. armenicus*). There is still considerable dispute among taxonomists regarding the precise status of these taxa. 5, 6 and 7 may be subspecies of 1; and 8 and 9 may be subspecies of 4.

European herring gull, which was given the name *Larus argentatus argentatus* is almost indistinguishable in its plumage from the American herring gull (*Larus argentatus smithsonianus*).

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molecular studies on their DNA indicated that they were not as closely related as had been supposed.

Evolution is still occurring in this gull complex as an ancestral species is splitting into new and separate forms, and then sometimes merging once more

Larus argentatus michahellis

- Occuring around Mediterranean coasts
- **Yellow-legged gulls** are spreading northward along the west coast of Europe, and the **Caspian gull** is spreading north from the Black Sea area in eastern Europe and **meeting** up with the European herring gull **in Poland**.

- For the biogeographer, it means that mapping the distribution of organisms and explaining such patterns that emerge are far from simple tasks (impossible for gulls of Northern Russia, to date)

Larus cachinnans

Cline and clinal variation

- Def. gradual change in genetics and form along a gradient.

- The chimpanzee (*Pan troglodytes*), for example, has 4 extant subspecies, all found in central and west Africa.

1- *Pan troglodites troglodites (nominate subspecies)*
2- Pan troglodytes vellerosus
3- Pan troglodytes verus (isolated from other taxa)
4- Pan troglodytes schweinfurthii

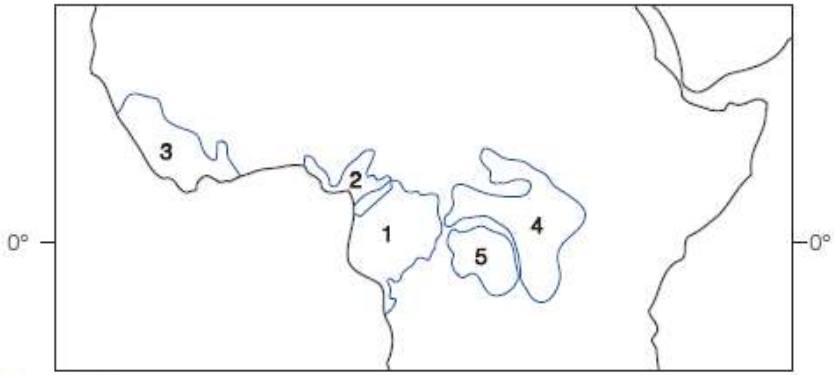


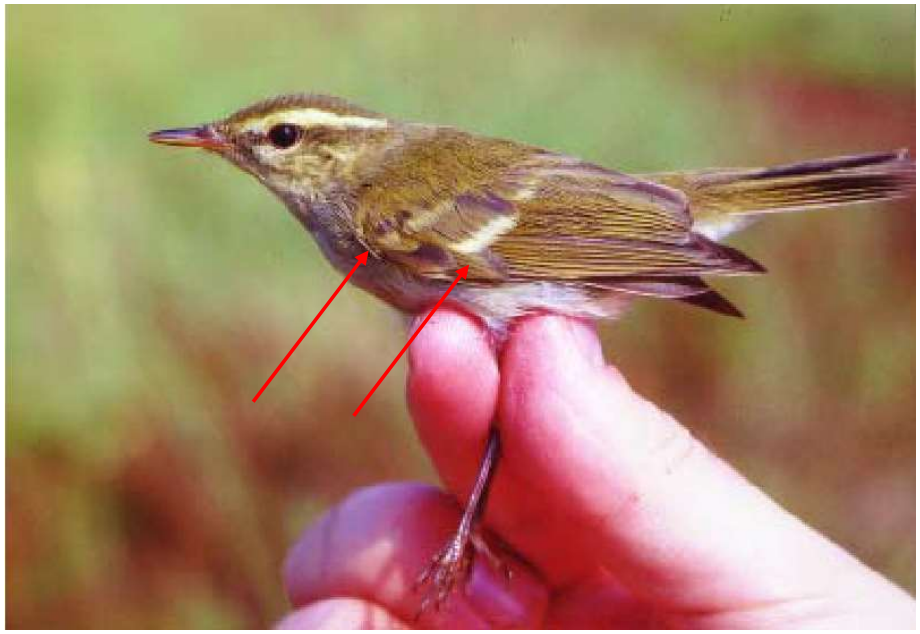
Figure 2.2 Distribution patterns of chimpanzee subspecies and bonobo in Central and West Africa: (1–4) the subspecies of chimpanzee, *Pan troglodytes*; (5) the bonobo or pygmy chimpanzee, *Pan paniscus*. More specifically: (1) the nominate *Pan troglodytes troglodytes*; (2) *Pan troglodytes vellerosus*; (3) *Pan troglodytes verus*; (4) *Pan troglodytes schweinfurthii*. The bonobo is found south of the River Congo and is hence separated from other chimpanzees by a formidable barrier to movement.

Ring species

greenish warbler
(*Phylloscopus trochilloides*)

- Sometimes a species may form a circle around a barrier

Phylloscopus trochilloides viridanus



Phylloscopus trochilloides plumbeitarsus

Where the two subspecies overlap in their range, they fail to interbreed, so subspeciation has reached a point where the two are regarded by some taxonomists as separate species.

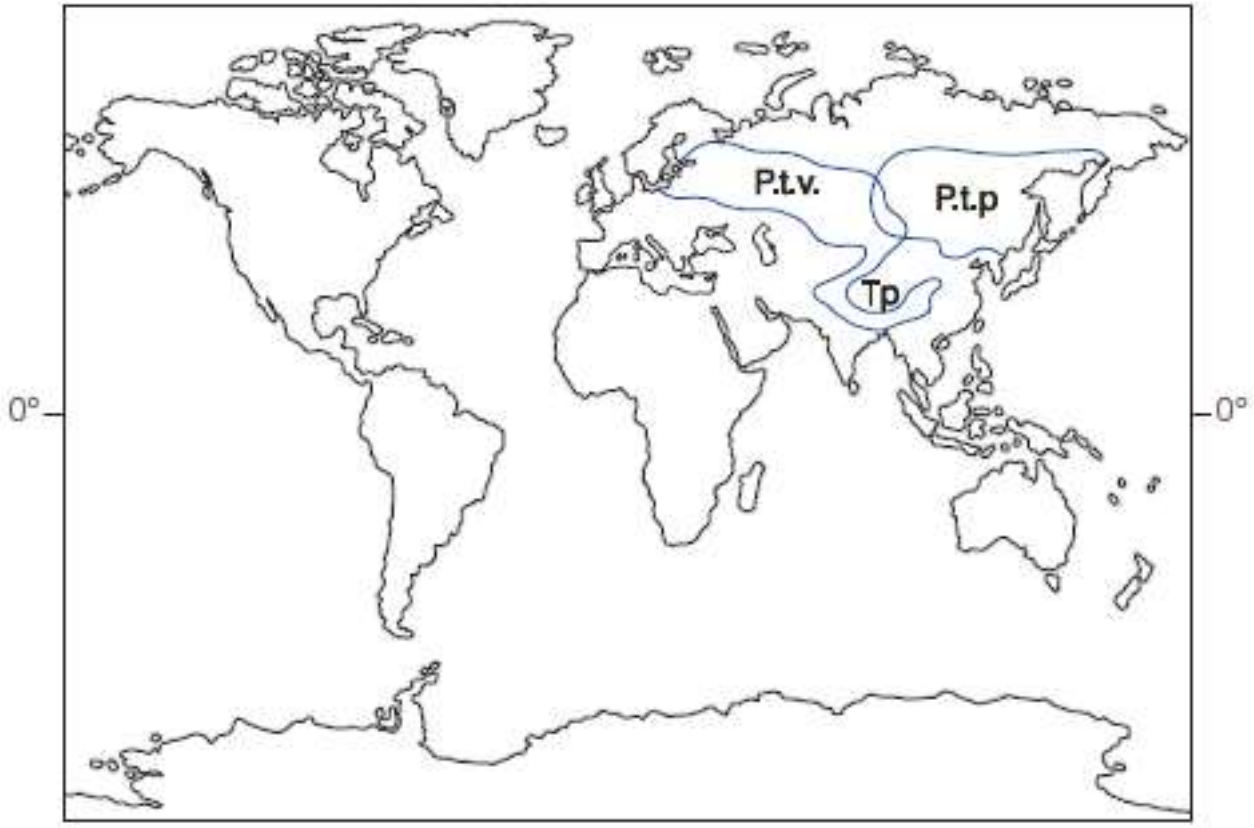


Figure 2.3 Breeding distributions of the greenish warbler (*Phylloscopus trochilloides*) in Asia. P.t.p. is the two-barred form of the greenish warbler, *Phylloscopus trochilloides plumbeitarsus*. P.t.v. is the single-barred form of the greenish warbler, *Phylloscopus trochilloides viridanus*. Between them, they form a ring around the harsh environment of the Tibetan Plateau (Tp). This is a rare example of an avian ring species. A further example of this process is shown in Plate 3.