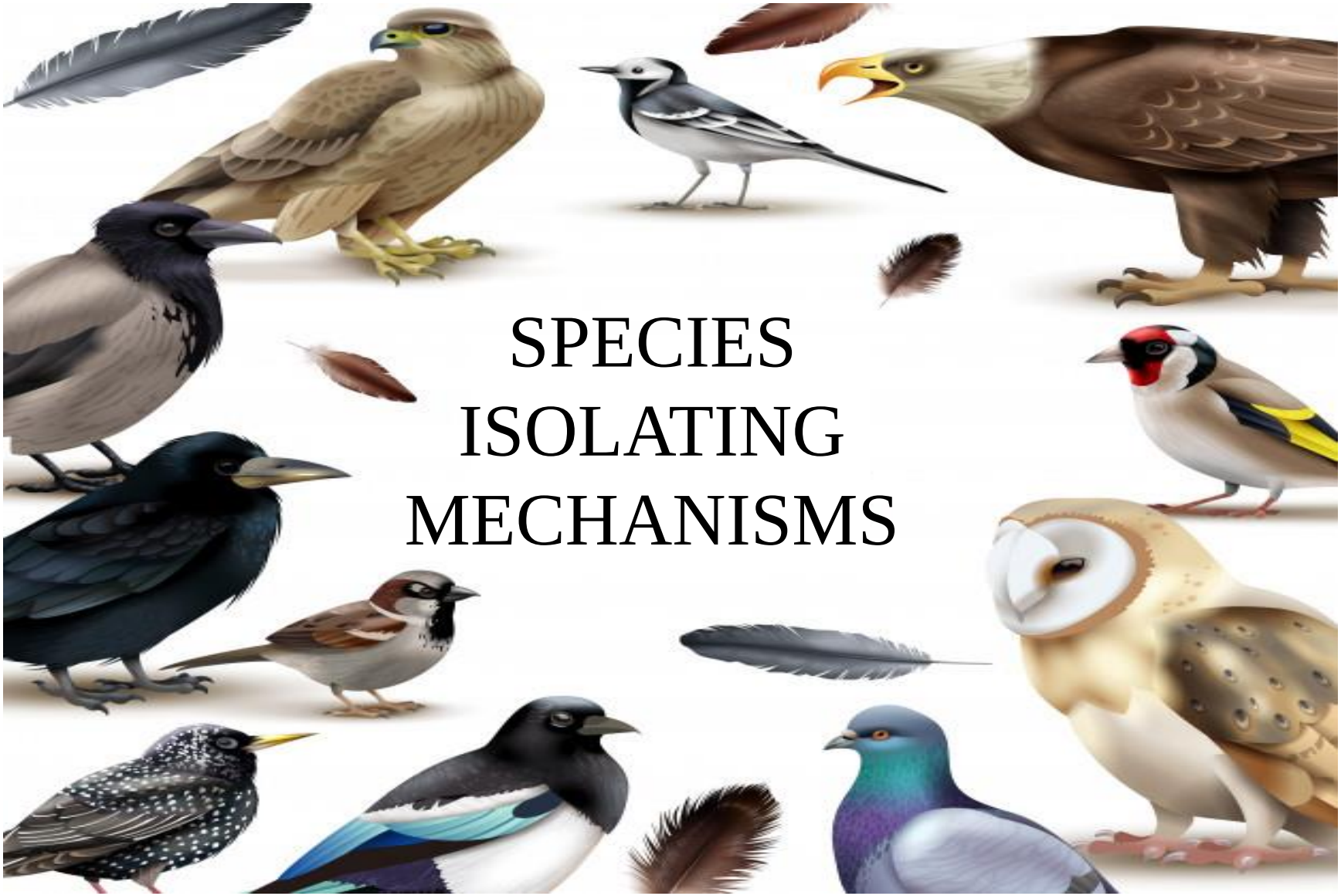

SPECIES ISOLATING MECHANISMS

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- Species refers to a group of individuals capable of interbreeding which remain reproductively isolated from other such groups.
- This isolation is the means for achieving distinctiveness of each species.
- Species isolation ensures that no adulteration of genes occurs and that the identity of each species is maintained.

- Thus, each species possesses a number of mechanisms that directly or indirectly prevent free interbreeding (gene exchange) between closely related species. These are termed as ISOLATING MECHANISMS.
- These mechanisms act among the members of the populations of same species or different species in due course of time.

ISOLATING MECHANISMS

PHYSICAL

- Geographical isolation

BIOLOGICAL

A
- Habitat or Ecological Isolation
- Seasonal or Temporal Isolation
- Behavioural or Ethological Isolation
- Mechanical Isolation

B
- Gametic Mortality
- Gametic Isolation
- Zygotic Mortality
- Hybrid Inviability
- Hybrid Sterility
- F2 generation Breakdown

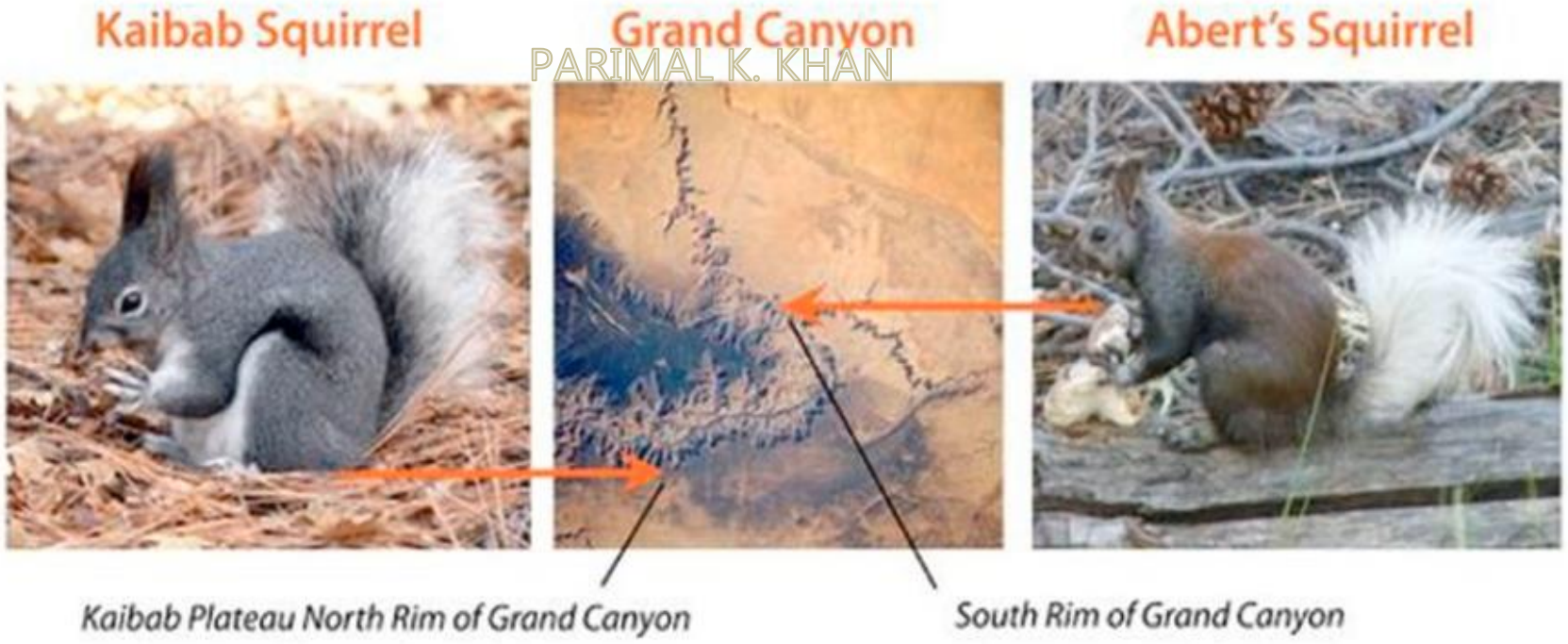
A — Pre-mating Isolation Mechanisms

B — Post-mating Isolation Mechanisms

GEOGRAPHICAL ISOLATION

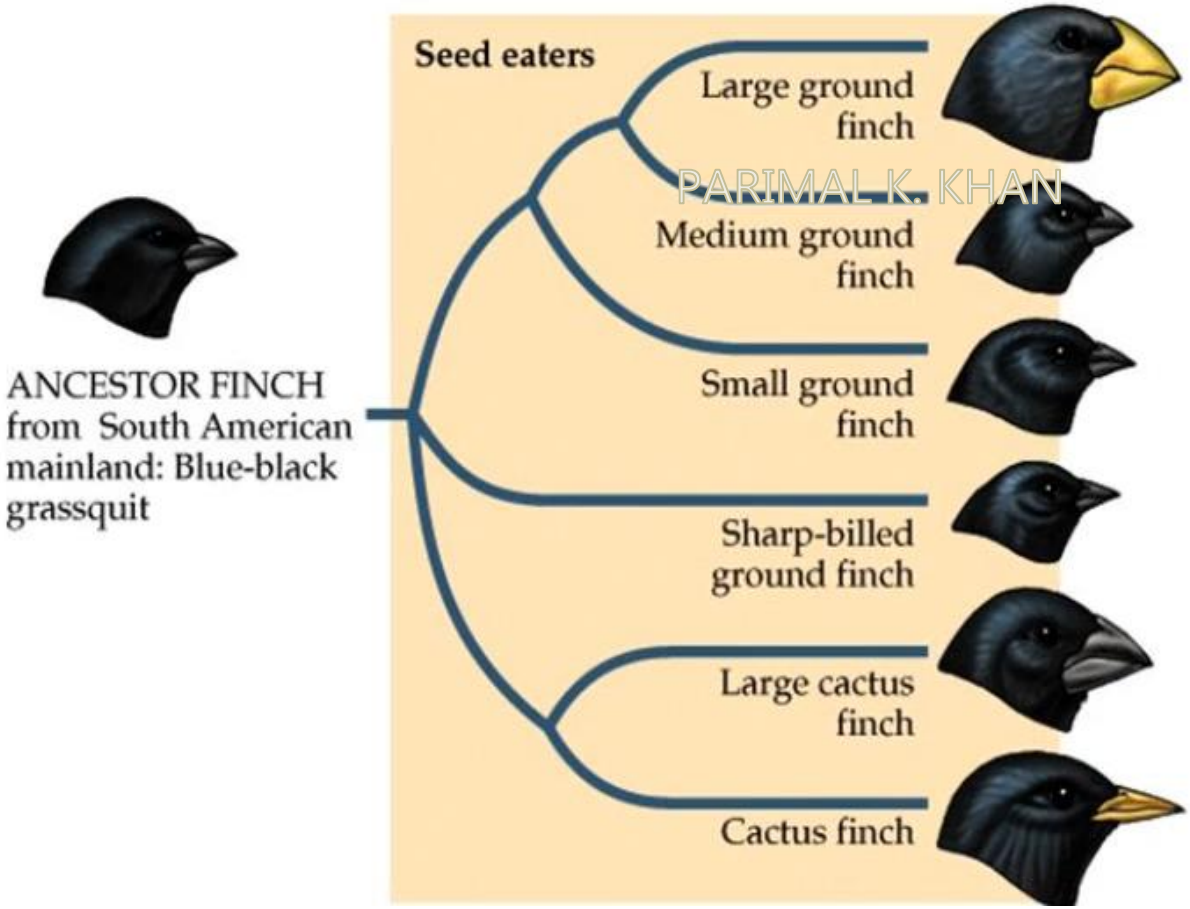
Geographic Isolation - Occurs when two populations are separated by geographic barriers

Examples = Rivers, Mountains, Canyons, and bodies of water.



Eg.: Darwin's finches.

Some finches from the mainland migrated to different islands due to lesser competition. Over time, this geographic isolation led to reproductive isolation and the formation of a new species which now failed to reproduce if brought together.



REPRODUCTIVE ISOLATION

- This type of isolation is achieved by either preventing the occurrence of mating (Pre-mating mechanisms) or ensuring failure of mating once it occurs by preventing successful formation of hybrids (Post-mating mechanisms).
- The Post-mating mechanisms usually develop first and then select for the Pre-mating mechanisms.

Pre-mating isolating mechanisms

- Potential mates do not meet due to habitat isolation.
- Potential mates meet but fail to mate either due to seasonal or ethological isolation.
- Potential mates may meet and mate but sperm transfer is prevented due to mechanical isolation.

Habitat isolation

- Organisms have different habitats or a preference for different ecological zones.
- Eg.: the pig frog *Rana grylio* lives in deep waters and the gopher frog *Rana areolata* prefers shallow waters.

Rana grylio

Rana areolata

Seasonal or Temporal isolation

- The potential mates attain sexual maturity at different times or seasons.

Wood frog
(Rana sylvatica)
It usually mates in late March or early April when water temperature is about 7.2°C (45°F)

Leopard frog
(Rana pipiens)
It usually mates in mid-April when water temperature is 12.8°C(55°F)

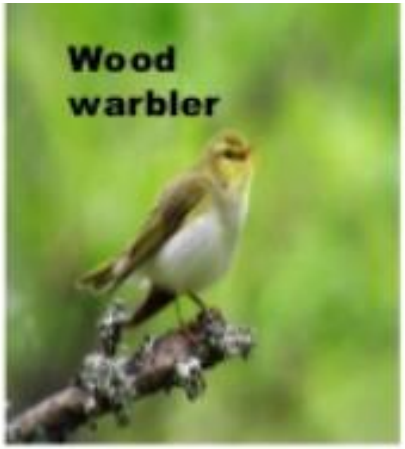
The western and eastern spotted skunks breed at different times of the year (fall and late winter).

Behavioural isolation

- Mating is prevented due to differences in courtship patterns of potential mates.
- This may be achieved by means of chemical, auditory or visual signals.
- Eg.: 37 different species of moths reside in the Scandinavian valley without any interbreeding.
- This is ensured by specific pheromones produced by each species.

Species that are behaviorally isolated are likely to have complex mating behaviors, such as elaborate mating rituals

ETHOLOGICAL (BEHAVIOURAL) ISOLATION



Chiff chaff,wood warbler & willow warbler are 3 different species which looks almost exactly same,but they donot interbreed due to difference in mating songs

Mechanical isolation

- Mating is restricted due to differences in reproductive structures.
- This form of isolation plays a more important role in plants.
- The cross between male *Gilia australis* and female *Gilia splendens* fails because of retarded growth of *G. australis* pollen tube.

Salvia mellifera

(Black sage)

Salvia apiana

(White sage)

Black sage &White sage grow in the same areas, but hybrids rarely form because flowers of 2 species have become specialized for distinct pollinators.Black sage flowers are pollinated by small bees &white sage flowers by large bees

This beetle penis has spikes on it - a mechanical barrier to reproduction with other species.

Post-mating isolating mechanisms

- In this case, even though the potential mates may meet and mate, successful fertilization is prevented by means of gametic mortality or gametic isolation.

- If fertilization occurs, the zygote may fail to develop (zygote mortality) or the hybrids formed from such a union may die prematurely (hybrid inviability).
- In case a hybrid survives, it is not allowed to be fertile (hybrid sterility).

Gametic mortality

- In this mechanism, interspecific cross destroys either the sperm or the egg.
- Patterson and Stone observed that in various interspecific *Drosophila* crosses, sperms encounter antigenic reaction in the genital tract of female and get immobilized and killed before getting a chance to reach the egg.

Gametic isolation

- Gametes of potential mates are not compatible with each other and fail to unite.
- This may be a result of specific proteins on surface of both egg and sperm which allows highly specific binding.
- The gametes of one species may fail to recognize the gametes of another species. Eg.: red and purple urchins.

Purple sea urchin (*Strongylocentrotus purpuratus*)

Red sea urchin (*Strongylocentrotus franciscanus*)

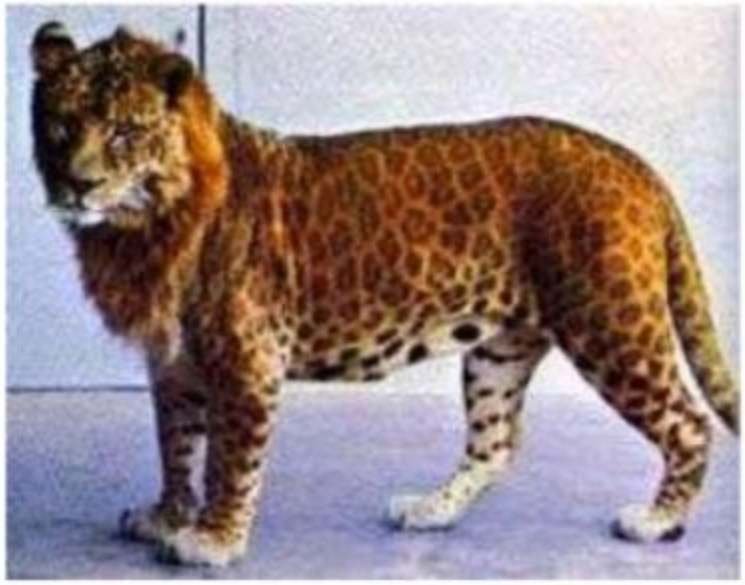
- Male gametes may not be able to recognize and fertilize an egg of a different species
- **EXAMPLE:** Sea cucumbers release their sperm and eggs into open water. The sperm recognize their own species through chemical markers

Zygote mortality

- After fertilization, zygote fails to develop due to high degree of incompatibility.
- Eg.: in *Ambystoma,* interspecific cross leads to a zygote that fails to develop due to degeneration of the nucleolus.
- Cross between male *Gilia splendens* and female *Gilia australis* fails due to degeneration of the endosperm.

Hybrid inviability

- A hybrid individual develops but either dies before birth or if born alive, cannot survive maturity
- **EXAMPLE:** When tigers and leopards are crossed, the zygote begins to develop but the pregnancy ends in miscarriage or stillborn



A leopon (lioness and leopard) or lipard (lion and leopardess) is sterile and has a very short life span. None have grown to maturity.

Hybrid sterility

- A viable hybrid, if formed, is not allowed to breed successfully and is infertile.

Zebroid: zebra & horse

Beefalo (domestic cow and buffalo)

Female horse

(2n=64)

Male donkey

(2n=62)

Mule

(2n=63)

Sterile,because synapsis and segregation cannot occur properly

Hybrid F_2 breakdown

- In case the hybrid is viable and fertile, the subsequent generations may not be able to perpetuate.
- Eg.: hybrids between different species of cotton.

- *Gossypium hirsutum* x *G. barbadense*

- Example: sunflower hybrids
  - 80% of F2 generation are defective in some way and cannot reproduce successfully

D.pseudoobscura

D.persimilis

F1

Fertile female

Parent

Sterile male

F2

Hybrid weaker than parent and F1 hybrids

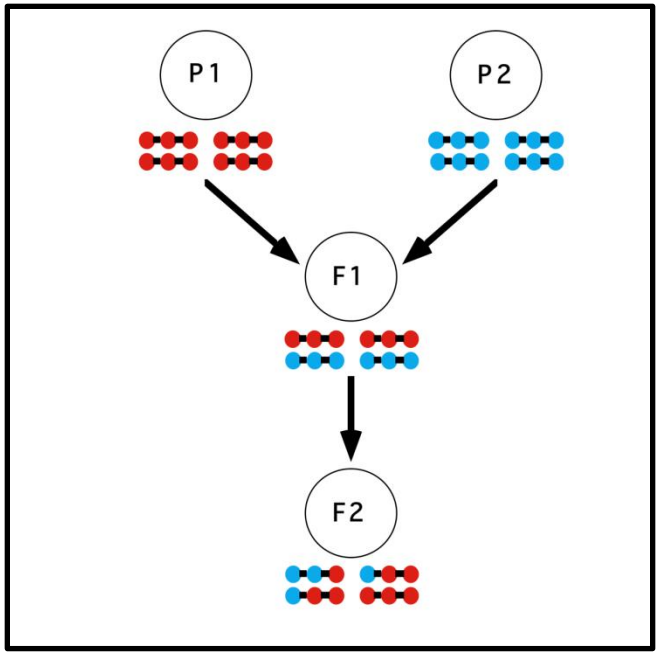


Image courtesy: Google India

Evolutionary significance of isolation

- The isolation of gene pool ensures that gains of evolution are kept undiluted.
- These mechanisms split interbreeding groups into several reproductively isolated groups which leads to speciation.
- Individuals are then subjected to macro and mega evolution resulting into formation of different phyla and classes.

THANK YOU.