



EVOLUTION

V Semester B.Sc. Zoology – Core Course VII

Dr. Swapana Johny

Asst. Professor & Head

Dept. of Zoology

Thin, long beak, for
finding seeds to eat



Thick, short beak, for
breaking open shells to
eat.



ISOLATION

INTRODUCTION

- ❖ Any external or internal barrier which prevent interbreeding between populations – isolation
- ❖ Population separated into smaller groups – exchange of genes prevented
- ❖ Genetic factors – mutations, recombination, genetic drift and natural selection – in one population not affect other population



TYPES OF ISOLATING MECHANISMS

- ❖ 1. Geographic Isolation
- ❖ 2. Reproductive Isolation
 - ❖ A. Prezygotic isolation
 - ❖ B. Postzygotic isolation

GEOGRAPHIC ISOLATION

- ❖ Geographical Isolation :- The spatial isolation of interbreeding populations of species by geographical and physical barriers.
- ❖ Extrinsic mechanism of isolation
- ❖ Barriers – vast stretches of land, water, high altitude mountain ranges, deserts, thick forests, canyons, deep fissures, etc.

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GEOGRAPHIC ISOLATION

- ❖ Geographical isolation on land – fauna of Australian region – Australia, Africa and South America – all in Southern Hemisphere - same range of latitude and same variety of habitats – widely different mammalian fauna.

GEOGRAPHIC ISOLATION

- ❖ Australia – pouched mammals, egg laying mammals. No placental mammals except introduced by human
- ❖ South America only Opossum
- ❖ Africa pouched mammals & egg laying mammals totally absent
- ❖ In Northern Hemisphere – fauna strikingly similar



GEOGRAPHIC ISOLATION

- ❖ Modern mammals originated in Northern hemisphere - migrated to other continents through narrow land connections – it submerged and connectivity lost.
- ❖ Australia isolated before placental mammals reached there.

CANYONS



DEEP FISSURES



Fig. 9 – Fissure gully crossing below above-grade pipe at a mine facility in Nevada
(photo by AMEC presented in 2004 ADOT workshop)



GEOGRAPHIC ISOLATION

- ❖ Galapagos – 900km west of Ecuador in South America – volcanic action – devoid of life – 13sps of Darwin's finches, terrestrial and marine iguanas, giant land tortoises, etc
- ❖ 1835 – HMS Beagle voyage
- ❖ Darwin ideas about Origin of Life from his visit to Galapagos islands



Common Cactus-Finch



Large Cactus-Finch



Small Tree-Finch



Medium Tree-Finch



Large Tree-Finch



Sharp-beaked Ground-Finch



Small Ground-Finch



Medium Ground-Finch



Large Ground-Finch



Gray Warbler-Finch



Green Warbler-Finch



Vegetarian Finch



Woodpecker Finch



Mangrove Finch

DARWIN'S FINCHES

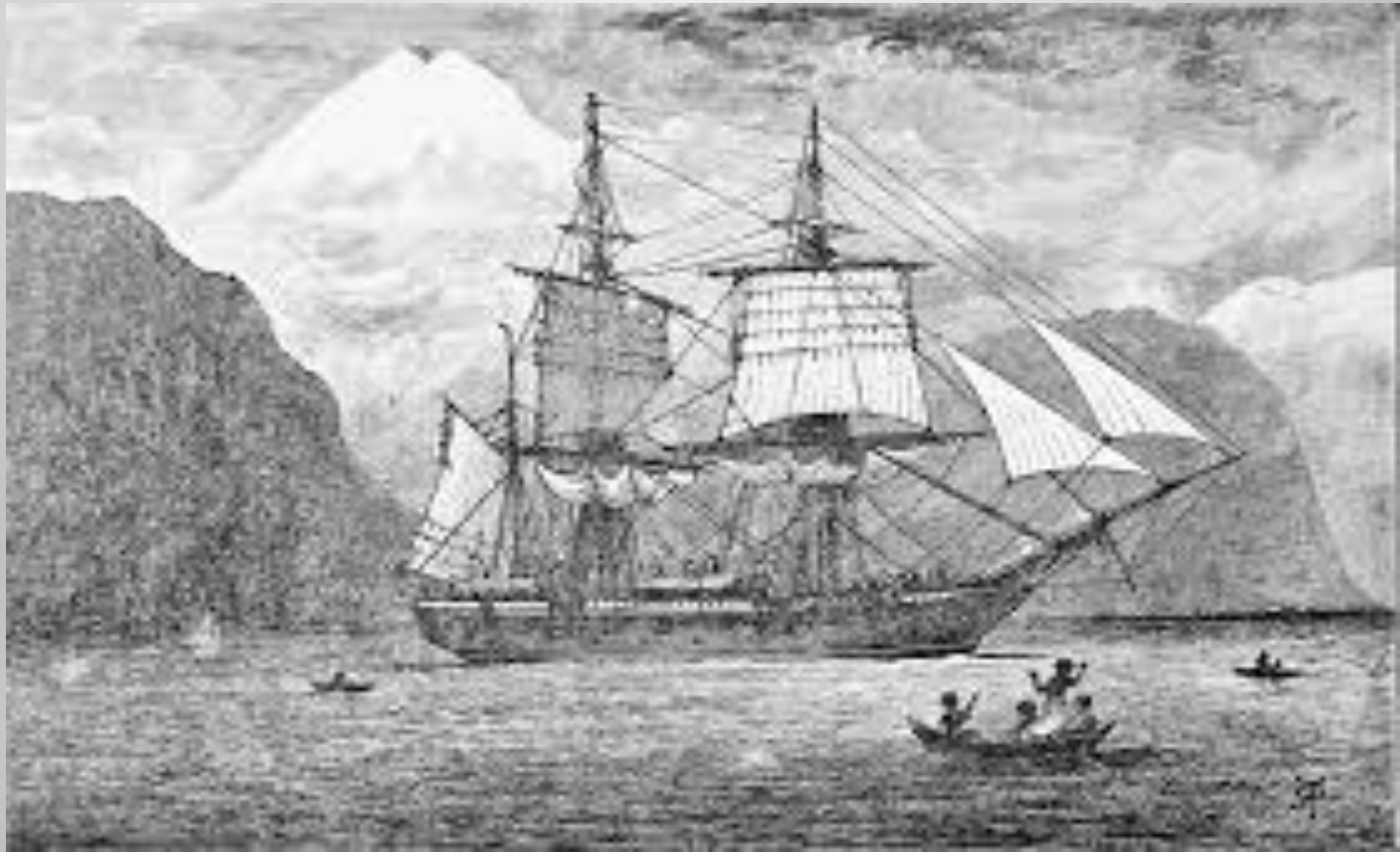
IGUANAS OF GALAPAGOS & NORTH AMERICA



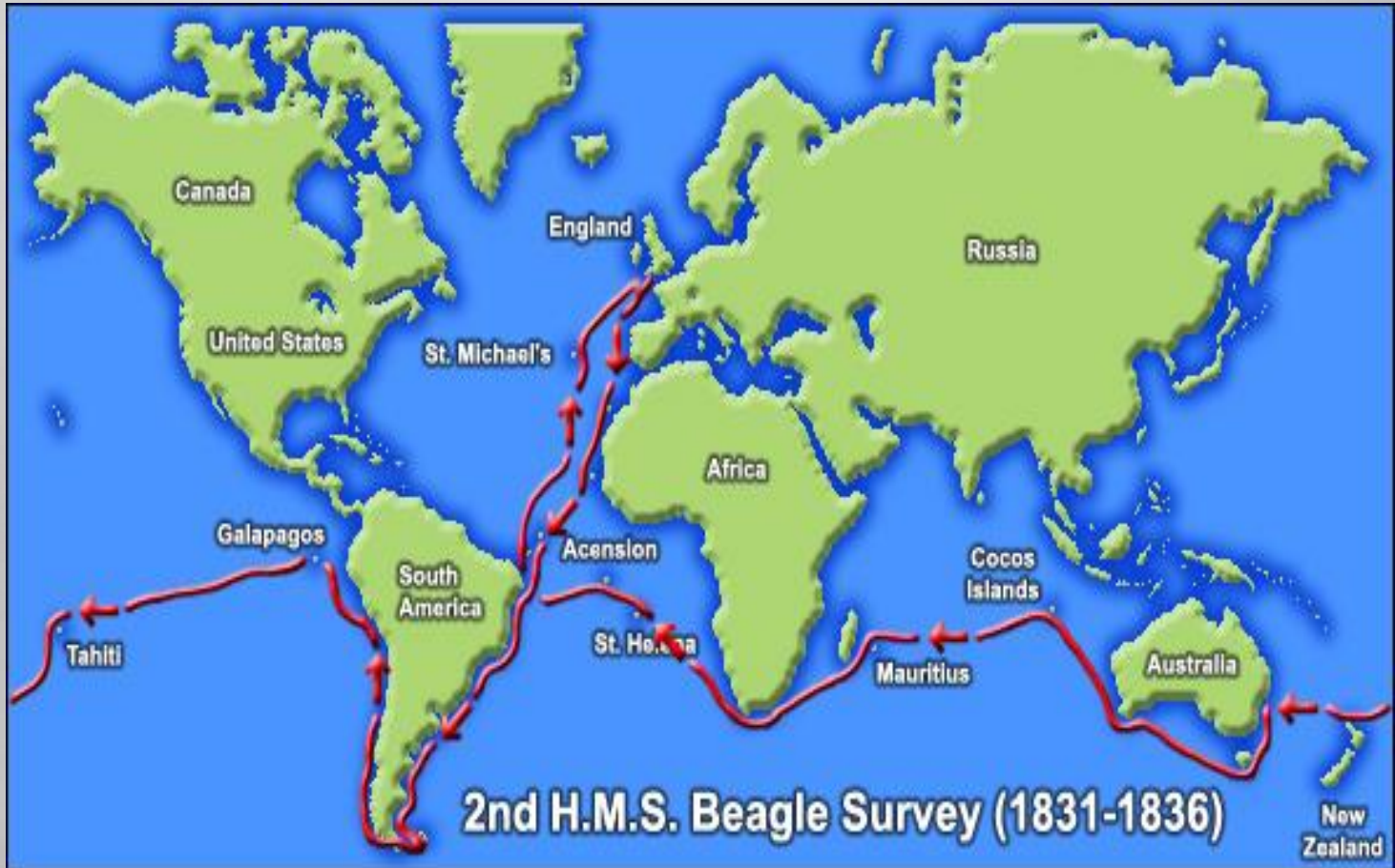
GALAPAGOS GIANT LAND TORTOISE



HMS BEAGLE



VOYAGE ROUTE OF HMS BEAGLE



GEOGRAPHIC ISOLATION

- ❖ Isolation in inland waters – land masses surrounding rivers, lakes, ponds and island swamps
- ❖ Flora and fauna of mountains- inability to cross low lands intervening between them
- ❖ Extensive forest isolate grassland organisms
- ❖ Prairies barriers for forest animals
- ❖ *Ratufa indica* – Indian Giant Squirrel – dark brown in Mysore range, light brown in Maharashtra & yellowish in Gujurat

RATUFA INDICA



GEOGRAPHIC ISOLATION

- ❖ Geographical isolation results in Allopatric speciation
- ❖ Core process of allopatric speciation rendering interbreeding of population impossible.
- ❖ New characters develop without losing their interbreeding nature but they can't interbreed due to geographical isolation

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REPRODUCTIVE ISOLATION

- ❖ Gene exchange limited or prevented by reproductive isolating barriers
- ❖ Intrinsic mechanism of isolation
- ❖ Reproductive isolation is the mechanism which prevents the interbreeding and genetic exchange between the different populations of a species.



REPRODUCTIVE ISOLATION

- ❖ Results in Sympatric Speciation
- ❖ Two types – Pre Zygotic Isolation & Post Zygotic Isolation

PRE ZYGOTIC ISOLATION

- ❖ Pre mating isolation
- ❖ Isolation prevents hybridization of members of different populations – no hybrids formed
- ❖ Prevents individuals from mating and fertilization



TYPES

- ❖ Habitat or ecological isolation
- ❖ Seasonal or temporal isolation
- ❖ Ethological or behavioural isolation
- ❖ Mechanical or morphological isolation
- ❖ Gametic isolation or gametic incompatibility

HABITAT OR ECOLOGICAL ISOLATION

- ❖ Isolation occurring when species occurs at different habitats in a general territory
- ❖ Populations of different habitats don't meet together for mating since their ecological preferences are different.
- ❖ Insect – coniferous tree isolated from an insect from deciduous tree in same forest.
- ❖ Beetles – burrowing in ground & on trees



HABITAT OR ECOLOGICAL ISOLATION

- ❖ Pig frog (*Rana grylio*) & Gopher frog (*Rana areolata*)
- ❖ Ecological isolation – separation due to differences in environmental factors – food, habits, physical requirements

SEASONAL OR TEMPORAL ISOLATION

- ❖ Members reaching sexual maturity at different seasons of the year
- ❖ Breeding season will not coincide even though living in same area.
- ❖ Eggs. – in North eastern USA 3 frog sps *Rana clamitans*, *R. pipens* and *R. sylvatica* breed in same pond – *R. sylvatica* – 44⁰ F., *R. pipens* – 55⁰ F & *Rana clamitans* – 60⁰ F and above only.- water temperature is the decisive factor.



SEASONAL OR TEMPORAL ISOLATION

- ❖ Salamanders – *Amblystoma tigrinum* (before end of March) & *A. maculatum* (after beginning of April) same area.
- ❖ Toads – *Bufo americanus* & *B. fowleri* - breeding in spring – different times.

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ETHOLOGICAL OR BEHAVIOURAL ISOLATION

- ❖ Absence of sexual attraction between females and males of different species. – mismatching sexual behaviour
- ❖ Elaborate courtship behaviours, mating rituals, songs mating calls, etc are different for different species which cannot be identified by organisms of other species



ETHOLOGICAL OR BEHAVIOURAL ISOLATION

- ❖ Closely related – gray tree frog (*Hyla versicolor*) & pine wood tree frog (*Hyla femoralis*) – breed in same pond – distinguishing mating calls.
- ❖ *Drosophila melanogaster* & *D. stimulants* – specific patterns of mating behaviour – any change in pattern – prevents breeding

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MECHANICAL OR MORPHOLOGICAL ISOLATION

- ❖ Different sizes and shapes of the external genital organs making copulation and sperm transfer difficult
- ❖ Dufour 1844 – lock and key theory
- ❖ Drosophila – resulting in injury and even death of organism

PHYSIOLOGICAL ISOLATION OR GAMETIC INCOMPATIBILITY

- ❖ Mating may take place but gametes are prevented from fertilization due to some physiological factors
- ❖ F R Lillie 1921 – Sea Urchin – sperm inability to fertilize even though living in same medium
- ❖ Patterson – *Drosophila* after mating vagina swells up blocking the entry of sperms to reach the eggs and prevents fertilization. Same sps blocking will be there for short duration – if interspecies swelling lasts for few days – preventing fertilization.

CYTOLOGICAL ISOLATION

- ❖ Fertilization cannot take place due to difference in chromosome number between two species
- ❖ Egs. Bronze frog and Bull frog – related species – different chromosome number.

Bronze frog



Bull frog



POST ZYGOTIC ISOLATION

- ❖ Post mating isolation
- ❖ Reduces the viability or fertility of the hybrids formed
- ❖ Categories :-
 - Zygotic mortality
 - Hybrid inviability
 - Hybrid sterility
 - Hybrid breakdown (F_2 breakdown isolation)



ZYGOTE MORTALITY

- ❖ Egg is fertilized but zygote dies soon.
- ❖ It cannot survive and undergo division for development
- ❖ Certain frog sps, Culex sps, etc.

HYBRID INVIABILITY

- ❖ Hybrids are formed by interspecific cross – but die before reaching sexual maturity
- ❖ At any stage of life death occurs
- ❖ Egs:- hybrid between Bull frog and Gopher frog – successively passes stages of development but die before reaching tadpole stage

HYBRID STERILITY

- ❖ Interspecific crosses – produce sterile hybrids
- ❖ Live to sexual maturity – cannot produce functional gametes – chromosomal incompatibilities
- ❖ Eg:- Mule – cross of Horse and Donkey



HYBRID BREAKDOWN

- ❖ F_1 hybrids are fertile and viable but further hybrid generations F_2 or back cross generations are inviable or sterile.
- ❖ This is F_2 breakdown isolation
- ❖ Egs:- Hybrid between *Drosophila pseudoobscura* & *D. persimilis*
 - female deposits as many eggs as normal female – back cross
 - offspring are weak and sterile.

*Thank
you*

