

BIOGEOGRAPHY



TOPICS

1. Zoogeography

2. Continental Drift Theory

3. Animal Distribution

4. Barriers to Animal Dispersal

Study Materials prepared by Dr. R. Debnath

for 3rd Sem (Gen) & 5th Sem (Hons TU)

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Zoogeography: A Brief Account



Zoogeography is the study of distribution of animals and plants on our planet, which occur in different regions of the world in a distinct pattern. The distribution of some animal species is so peculiar that it is difficult to explain their occurrence in a particular region. Zoogeography attempts to understand the complexities as well as the simplicity in the distribution of animals in the light of evolutionary and environmental influences.

Zoogeography is the branch of the science of biogeography that is concerned with the geographic distribution (present and past) of animal species.



Wallace: Zoogeography



- * Studying animal distributions (animal geography)
- * **Father of animal geography/biogeography.**
- * Co-discoverer of theory of natural selection.

".....every species comes into existence coincident in time and space with a preexisting closely allied species." (1855)



Biogeographic Regions: Six (6) Principal Zoogeographical Realms

- 1. **Palearctic**: Europe, northern Africa, and northern Asia
- 2. **Nearctic**: N. America including about 2/3 of Mexico and Greenland.
- 3. **Neotropical**: lower 1/3 of Mexico, Central and South America.
- 4. **Ethiopian** : Sub-Saharan Africa, adjacent Arabian Peninsula.
- 5. **Oriental**: Indian subcontinent and adjacent regions of southern Asia.
- 6. **Australian**: Includes Australia, Tasmania, New Guinea, and New Zealand

NOTE: Nearctic and the Palearctic make up the **Holarctic**. Biogeographic boundaries between the Palearctic and the Ethiopian regions and the Nearctic and Neotropical are similarly difficult to locate. Demarcation of boundary between the Oriental and Australian biogeographic regions is the **Wallace's line**.

Zoogeographical Regions



There are mainly six (6) zoogeographical regions, each more or less embracing a major continental land mass and all have long been separated from one another by water (oceans and fresh-water bodies), mountain ranges or desert, so that, each region has evolved its distinctive and characteristic orders and families of animals. These major distributional units were first recognised by Sclater (1858), modified by Huxley (1868), extended by Wallace (1876) and best described in a modern way by Darlington (1957) and others. The six zoogeographical regions are the **Palearctic**, the **Nearctic**, the **Neotropical**, the **Ethiopian**, the **Oriental** and the **Australian**.

NOTE: Because some zoogeographers consider the Neotropical and the Australian regions to be so different from the rest of the world, these two are often considered as regions or realms equal to the other four combined. They are classified as **Neogea** (the Neotropical), **Notogea** (the Australian) and **Met (=g)agea** (the Palearctic, Nearctic, Ethiopian and Oriental). Some authors also like to add the 7th as **Oceanian Realm** comprising NZ & small islands.

Zoogeographical Regions: Modern View



The widely accepted modern classification of land masses into regions is given below which is based on Wallace (1876) and Darlington (1957).

1. Realm MEG(=T)AGEA

1. **PALEARCTIC** (Europe, Russia, Mediterranean).
2. **NEARCTIC** (North America up to the middle of Mexico).
3. **AFRICAN** (= **ETHIOPIAN**) (Africa south of Sahara).
4. **ORIENTAL** (Tropical Asia south of 30° latitude).

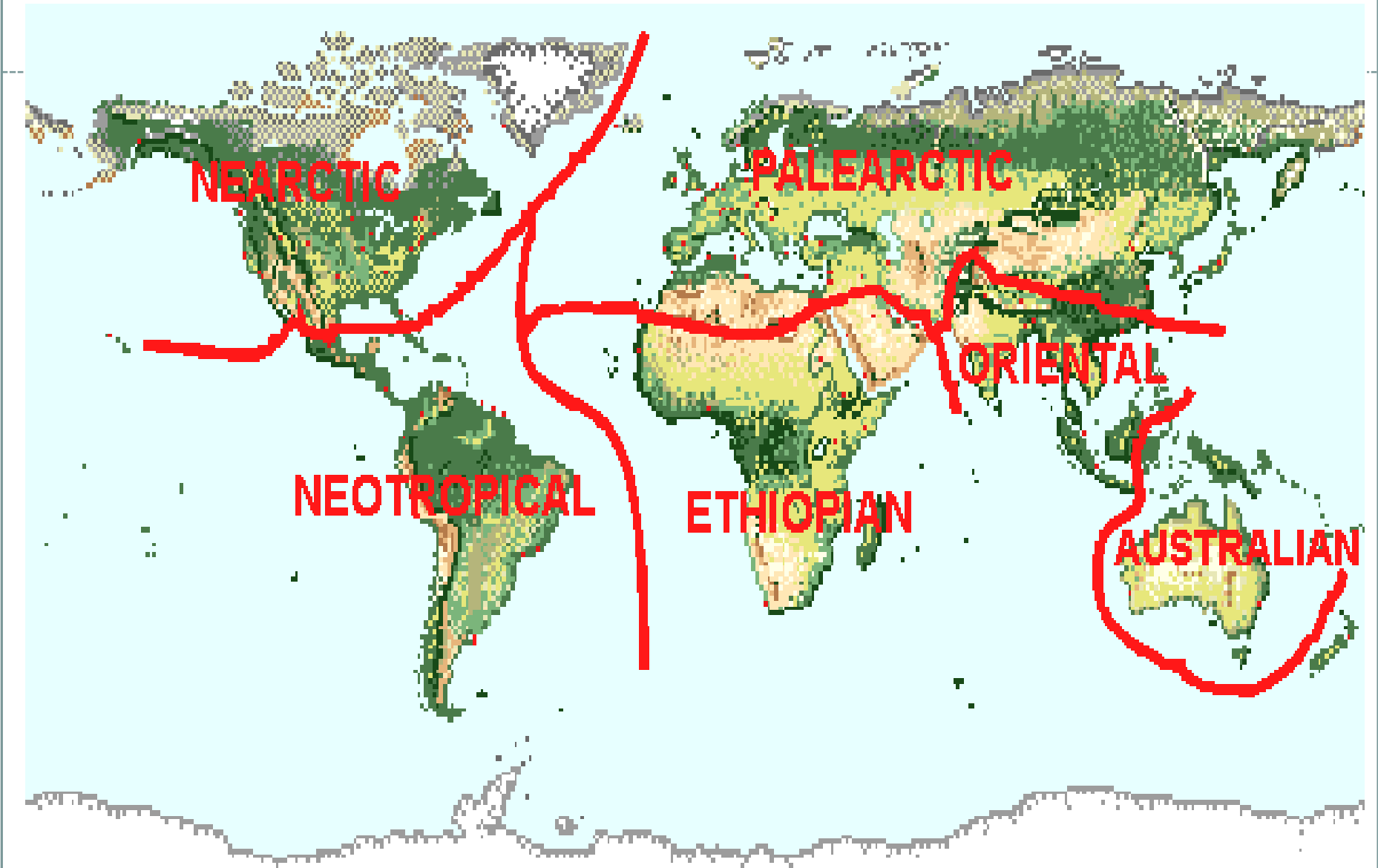
2. Realm NEOGEA

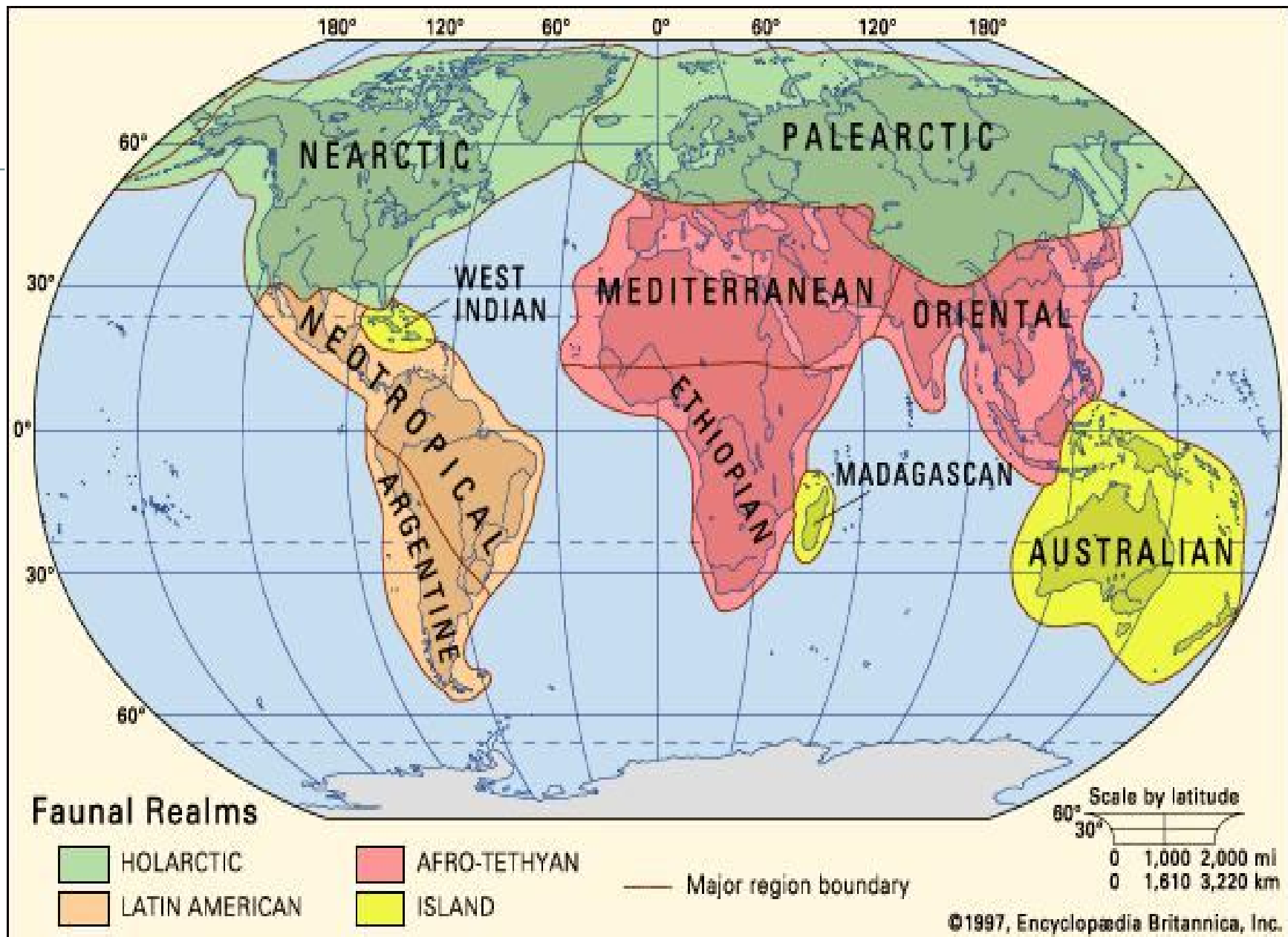
5. **NEOTROPICAL** (South America, tropical Mexico and Caribbean Islands).

3. Realm NOTOGAEA

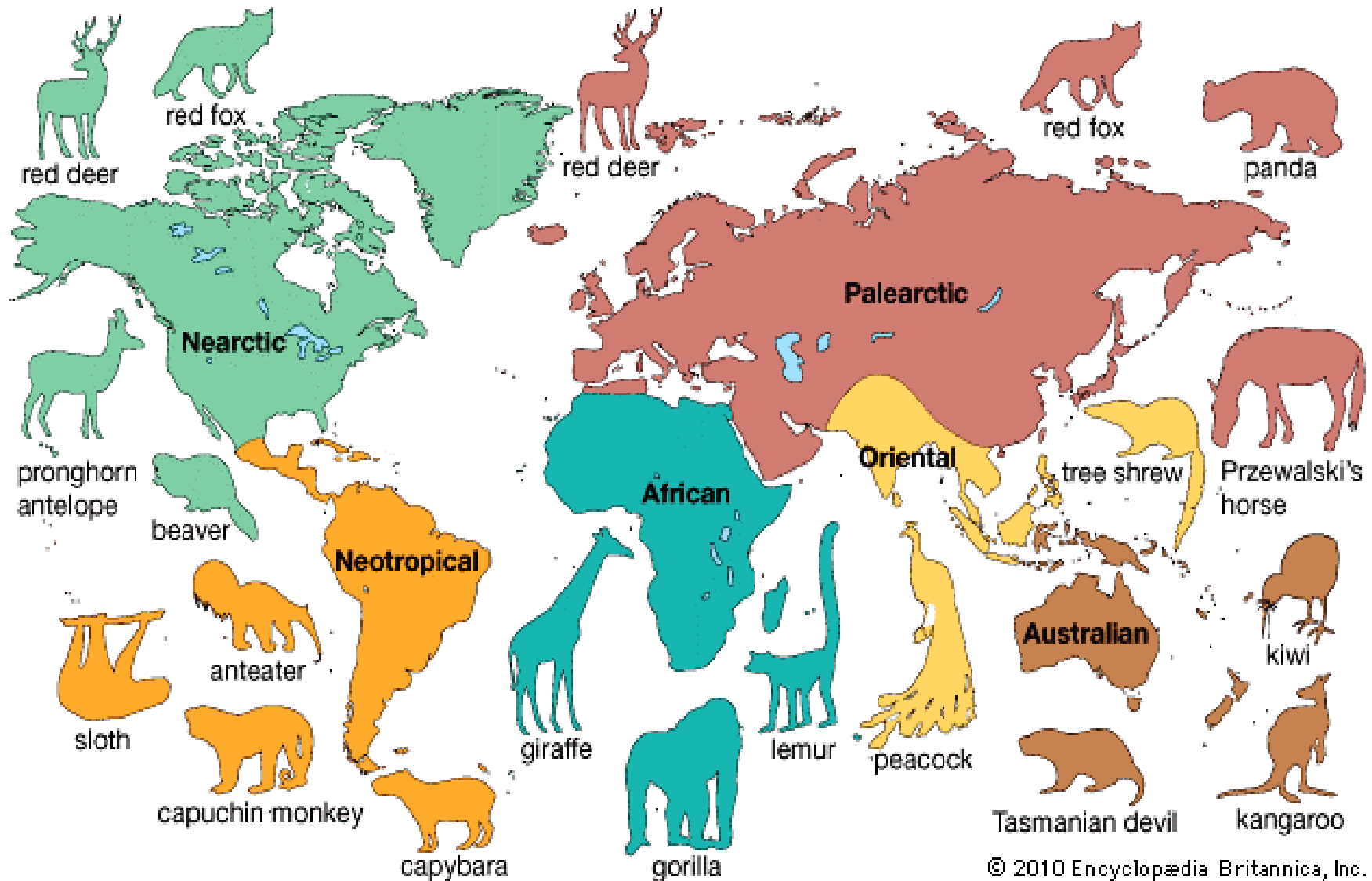
6. Region **AUSTRALIAN** (Australia, Tasmania, New Guinea and New Zealand).

Zoogeography: Six Principal Realms





Zoogeographic regions and some characteristic animals



Zoogeographic Regions

History

Faunal regions proposed by [Alfred Russel Wallace](#), co-discover of the Theory of Evolution by Natural Selection.

Comparisons of the Mammals of the Faunal Regions.



1. Palearctic (PA)

A. Europe, North Africa (to Sahara), Asia (except India, Pakistan and SE Asia) and Middle East.

B. Number of families = 36; endemics = 1

2. Nearctic (NA)

A. Canada, USA, Mexico to tropics

B. Number of families = 31; endemics = 2.

Note: Holarctic is Palearctic plus Nearctic

3. Neotropical (NT)

A. tropical Mexico south to South America, plus the Antilles

B. Number of families = 56; endemics = 28.

4. Afrotropic (AF) or Ethiopian (ET)

A. Madagascar, Africa south of the Sahara, southern Arabian Peninsula

B. Number of families = 58; endemics = 20.

5. Indo-Malayan (IM) or Oriental (OR)

A. Pakistan, India, Southeast Asia, Philippines, Indonesia west of Wallace's line (Sumatra, Java, Borneo)

B. Number of families = 49; endemics = 8.

6. Australian (AU)

A. Australia, New Guinea, Tasmania, Indonesian Islands east of Wallace's line (Sulawesi, Timor, etc.)

Note: does not include New Zealand

B. Number of families = 35; endemics = 21.

7. Oceanic

A. Oceans of the world and truly oceanic, isolated, small islands

Richness of Vertebrates (overall), Birds and Mammals in 6 Zoo-geo-Realms

COMPARATIVE RICHNESS OF THE SIX REGIONS.

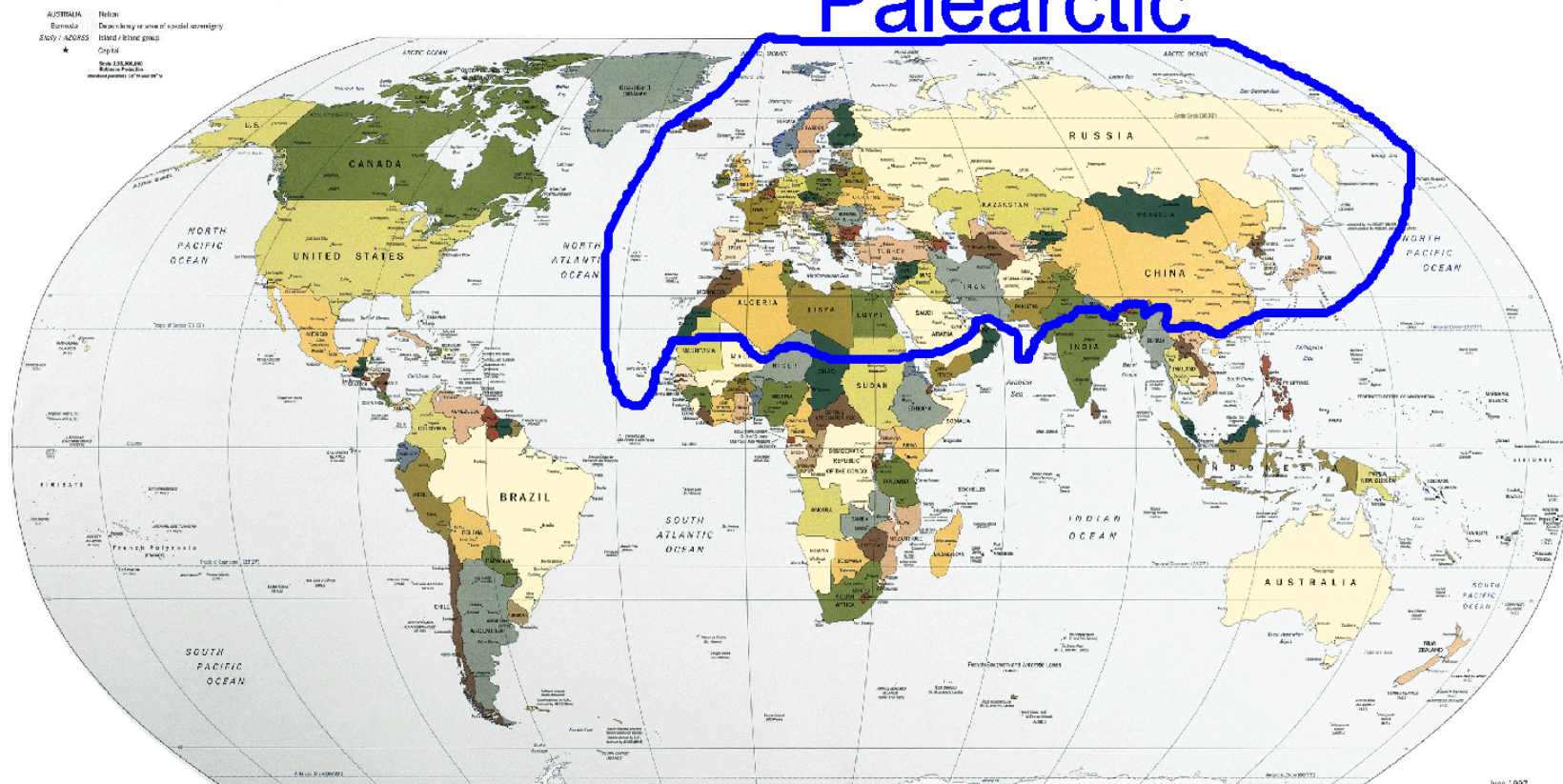
REGIONS.	VERTEBRATA.		MAMMALIA.			BIRDS.		
	Fami- lies.	Peculiar families.	Genera.	Peculiar genera.	Per centage.	Genera.	Peculiar genera.	Per centage.
Palæarctic...	136	3	100	35	35	174	57	33
Ethiopian ...	174	22	140	90	64	294	179	60
Oriental	164	12	118	55	46	340	165	48
Australian...	141	30	72	44	61	298	189	64
Neotropical..	168	44	130	103	79	683	576	86
Nearctic	122	12	74	24	32	169	52	31

Characteristic Avian Fauna of Six Zoogeographic Regions



Matrix Comparing Faunal Regions

Region	Percentage of families found in					
	PA	NA	NT	ET	OR	AU
1. Palearctic (PA)	---	46	24	54	76	32
2. Nearctic (NA)	40	---	60	25	30	18
3. Neotropical (NT)	28	81	---	21	24	18
4. Ethiopian (ET)	67	35	22	---	66	32
5. Oriental (OR)	90	40	24	63	---	57
6. Australian (AU)	21	13	10	17	32	---



FAUNAL CHARACTERISTICS OF PALEARCTIC REALM

Fishes : Sucker fish (*Echenis*), Salmon fish, etc.

Amphibians : Salamanders, eg. *Proteus*, etc.

Reptiles : lizard *Trigonophis*, sand boa etc.

Birds : Tern, wren, finches, Gees etc.

Mammal: Wild dog (wolf), wild pig, hedgehog (*Hystrix*), Mole rat, etc.

It is suggested that vertebrate fauna of palaearctic region is not very rich and shows overlapping nearctic region with New world and old world fauna.

1. PALEARCTIC REALM



Characteristics:

- a) Largest region
- b) Includes Europe, north Africa, much of Middle East, most of Asia (except south-southeastern Asia)
- c) Diverse biomes: polar ice (N) to desert (S)

Sub-Regions:

- a) European Sub-region
- b) Mediterranean Sub region
- c) Siberian sub region
- d) Manchurian Sub region

Climate: This is the largest of the Six regions is covering an area of 14,000,000 square miles. In this region we find Europe, Asia, North of Himalayas and Northern parts of Africa. The lands bordering the Mediterranean Sea in southern Europe, north Africa, and western Asia are home to the Mediterranean Basin eco-regions, which together constitute the world's largest and most diverse Mediterranean climate region of the world, with generally mild, rainy winters and hot, dry summers.

Few Mammals of Palearctic realm



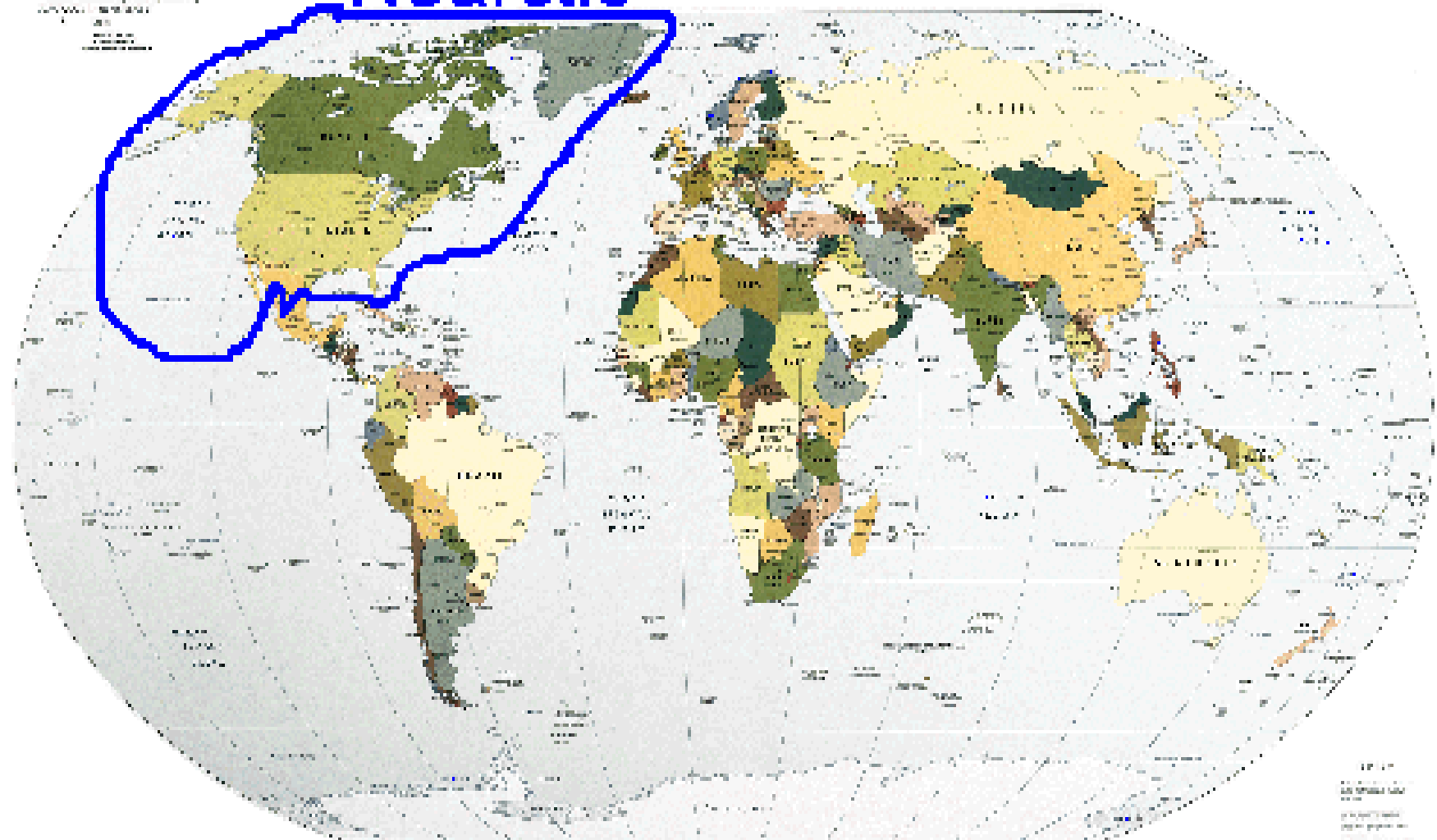
Palearctic Fauna:

Gray wolf, Norway rat, Siberian tiger, giant panda, Polar bear.



Political Map of the World, June 1997

Nearctic



Palearctic & Nearctic realms are collectively called Holarctic Region

2. NEARCTIC REALM



Characteristics:

- a) Most of North America, Greenland
- b) Latitudinal biome diversity similar to Palearctic
- c) Polar ice (N) to desert & subtropical (S)
- d) This region is known as “**Head quarters of urodels**”

Sub-Regions:

- a) California Sub-region
- b) Rocky mountain sub-region
- c) Alleghasy Sub-region
- d) Canadian Sub region

Climate: This region includes the north American continent up to the middle of Mexico. Climate is temperate with an arctic edge. There are grasslands in the middle of the continent. Western part is arid with mountains and coniferous forests. Like Palearctic region this has extreme cold and hot climate.

Few Mammals of Nearctic realm



FAUNAL CHARACTERISTICS OF [NEARCTIC REALM](#)

Fishes: Garpike, Paddle fish etc.

Amphibians: Salamanders, like *Amphiuma*, *Amblystoma* (Axoltl larva), etc.

Reptiles: Rich number of Reptiles like, Musk turtle, *Trionyx*, Alligators *Ophiosaurus*, and Colubrid vipers, like *Pituophis couophis* and *Chilomeniscus* are present.

Birds: Pelicans, Heron, Humming birds, Woodpeckers, Mocking birds, Larks and Sand- pipers are present.

Mammals: Squirrels, Moles, Rabbits, Beavers, Cats, Bats, Deers, Bears, Weasels, Opposum, Porcupine and Armadillo are present.



Nearctic Region- Endemic Reptiles

- Exclusive Nearctic Lizards

- Gila Monster *Heloderma* (excl fam.)- poisonous lizard
- An endemic genus of land tortoise, *Gopherus* (Gopher tortoises)
- Anniellids (*Anniella* sp.) legless lizard



Gopherus sp.



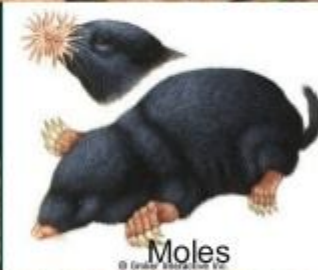
Gila Monster, *Heloderma*

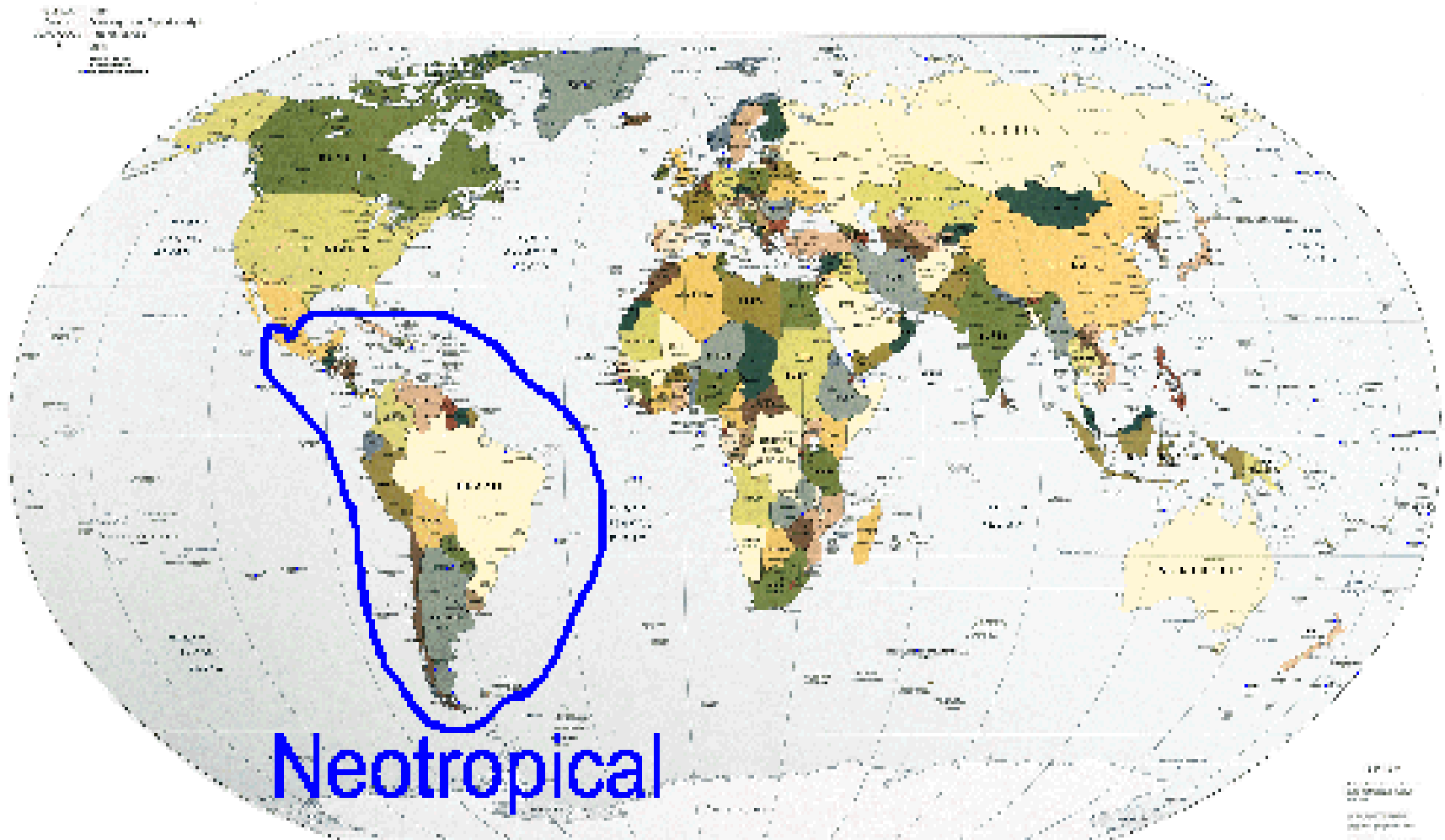


Anniella sp.

Nearctic Region- Mammals

- Holarctic Fam.-(Nearctic and Palearctic)
- Moles
- Pikas
- Zapodidae- Jumping Mice
- Beavers (*Castor canadensis*)





3. **Neotropical Realm:** This region shows tropical conditions. The southern part of South America shows temperate zones, because of these varied environmental conditions luxuriant forests, deserts, plains and rivers are common in Neotropical region

3. NEOTROPICAL REALM



Characteristics:

Neotropical region includes S. America, Central America, Mexico and West Indies. This is divided into 4 sub- regions.

Sub-Regions:

- 1 Chillian sub region
- 2 Brazelian sub region
- 3: Mexican sub-region
4. West Indies or Antelian sub-region.

Climate:

This region includes the north American continent up to the middle of Mexico. Climate is temperate with an arctic edge. There are grasslands in the middle of the continent. Western part is arid with mountains and coniferous forests.

FAUNAL CHARACTERISTICS OF NEOTROPICAL REALM

Fishes: *Lepidosiren* (lung-fish), *Lepidosteus* (Gar- pike), etc.

Amphibians : Anurans, like *Pipa*, *Hyla*, *Bufo*, *Rana*, etc. Caecelians, like *Siphanophis*, *Rainotrema*, Urodeles are very few.

Reptiles are Crocodiles, Alligator, many turtles and Tortoises are common in this region (*Dermatemys*, *Stourotypus*, *Peltocephalus*), important lizards are *Helodermidae* (Poison lizard), *Andidae*, *Crocodylidae*, Coral snakes, Pit vipers, *Typhlops* and many other snakes are present.

Birds: *Rhea americana* (3 toed ostrich), *Tinamus* (Flightless bird is Endemic to this region), Ducks, Pigeons, Patrots, Swifts, Wood peckers, King fishers, Starks, *Vultur gryphus*, *Pterocnemia pennata* and *Ara macao*, etc.

Mammals: New World monkeys, Armadillos, Ant eaters, Didelphis, *Desmodus rotundus*, *Myrmecophaga tridactyla* (giant anteater), *Tapirus terrestris* (tapir), *Lama vicugna*, *Lama guanicoe*, *Panthera onca*, *Arctocephalus australis*, *Cavia aperea*, *Bradypus tridactylus* (three-toed sloth) etc.



Few Animals of Neotropical Region



**Neotropical
Animals:** Sloth,
Amazonia
Anaconda,
Howler monkey,
Tapir,
Capybara.



Political Map of the World, June 1997

4. Ethiopian Realm



The old world counterpart of the Neotropical is the Ethiopian, which includes the continent of Africa, south of the Atlas Mountain and Sahara Desert, Southern Arabia, Madagascar and Mauritius. It embraces tropical forests in central Africa and in the mountains of East Africa, Savanna, grasslands and deserts. It includes a varied vertebrate fauna and several endemmic families.

4. ETHIOPIAN REALM

Characteristics:

Africa, though northernmost Africa is more similar to Europe (Palearctic realm), is characteristic with antelopes, giraffes, elephants, rhinoceros, gorillas, dogs, and cats. This is sometimes called the African or Afrotropical realm. In this realm Africa, Sahara desert, Southern part of Arabia, Madagascar Island are included. This region shows extensive desert on the North side. It is called “Sahara desert”. On its Western side thick forests are present. Rest of Africa shows Greenland.

Sub-Regions:

1. East African sub region
2. West African sub region
3. South African sub region
4. Malagassy sub region

Climate: Ethiopia is in the tropical zone laying between the Equator and the Tropic of Cancer. It has three different climate zones according to elevation. Naturally it has 3 distinct CLIMATE ZONES, such as, **1. Tropical zone (Kolla)** - is below 1830 metres in elevation and has an average annual temperature of about 27 degree Celsius with annual rainfall about 510 mm. The Danakil Depression (Danakil Desert) is about 125 metres below sea level and the hottest region in Ethiopia where the temperature climbs up to 50 degree Celsius. **2. Subtropical zone (Woina dega)** - includes the highlands areas of 1830 - 2440 metres in elevation has an average annual temperature of about 22 degree Celsius with annual rainfall between 510 and 1530 mm. **3. Cool zone or Temperate Zone (Dega)** - is above 2440 metres in elevation with an average annual temperature of about 16 degree Celsius with annual rainfall between 1270 and 1280 mm.

FAUNAL CHARACTERISTICS OF ETHIOPIAN REALM

Fishes: Fish fauna is diverse. African fresh water lung fish, *Protopterus* characteristic; other endemic fishes are Tuna, Cat fishes, Electric eels etc.

Amphibians: Anurans, like *Rhacophorus*, *Hyla*, *Microhyla*, *Xenopus* (Clawed Toad) and many caecilians (Apoda) are abundant.

Reptiles in Ethiopian region : Crocodiles (*Crocodylus niloticus*, etc.) and Chelones (*Testudo*, *Trionyx* etc.) the characteristic of this region Chamaeleon (*Chamaeleo* sp.); various lizards, like, *Monotrophis*, *Cordylus*, *Agama*, etc. Amongst Snakes some characteristic examples are *Leptorhynchus*, *Rhamnophis*, *Dendroaspis polylepis* (Black Mamba), *D. angusticeps* (Green Mamba), the puff adder (*Bitis arietans*), Boomslang (*Dispholidus typus*), Gaboon viper (*Bitis gabonica*), Egyptian cobra (*Naja haje*), Spitting Cobra (*Naja mossambica*, *N. nigricincta*, *N. nigricollis*), Carpet viper (*Echis ocellatus*), African rock python (*Python sebae*), African blind snake (*Typhlops bibronii*), etc.

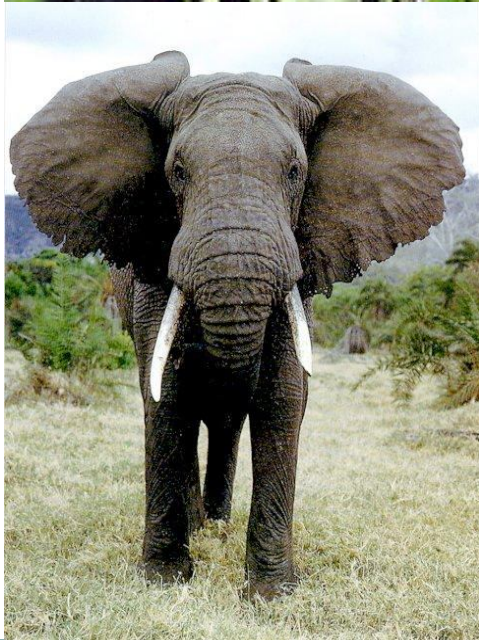
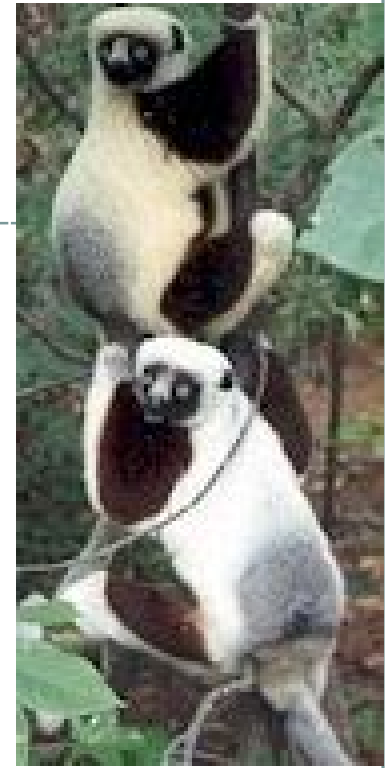
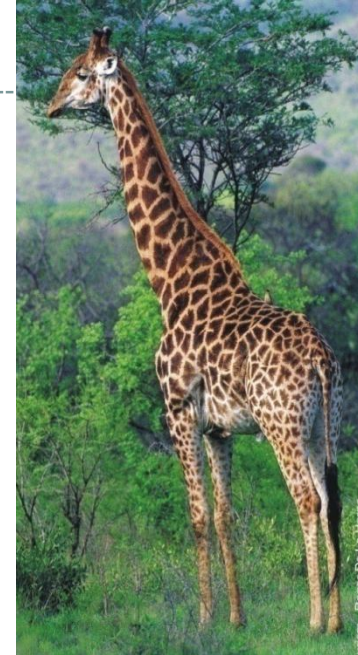
Birds in Ethiopian region : The most important birds is the two toed Ostrich *Struthio camelus*. Other birds are Horn bills, Herons, Pigeons, Parrot, Cuckoos, Storks, Finches etc.

Mammals in Ethiopian region: Hyaena (*Aye aye*), flying lemur(*Galeopithicus*), two species of gorilla (western gorilla, *Gorilla gorilla*, and eastern gorilla, *Gorilla beringei*) and both species of chimpanzee (common chimpanzee, *Pan troglodytes*, and bonobo, *Pan paniscus*). Humans and their ancestors originated in Africa. Equus equus (Horse), Elephant (*Loxodonta africana*), Tiger (*Panthera tigris*), lion (*Panthera leo*), Leopard (*P. pardus pardus*), Camel (*Camelus*), Pig (*Phacochoerus africanus*), Donkey (*Equus acinus*), etc. Mammals of Ethiopian region have shown resemblances with the mammalian fauna of Oriental region. It is because they have a land connection previously.

Collage of Endemic Animals found in Ethiopian Realm



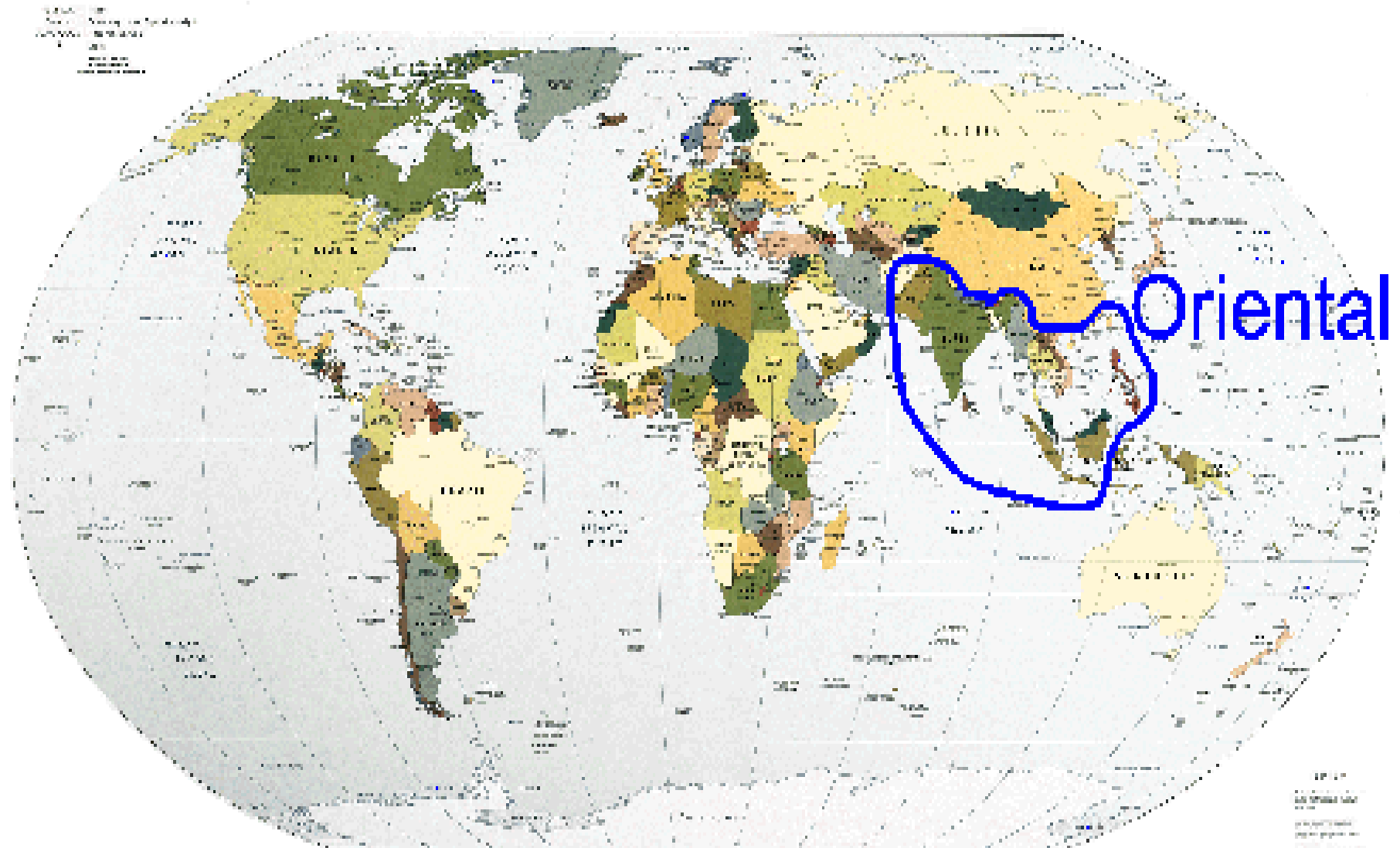
Few Mammals of Africa



Ethiopian Fauna: 52 mammal families, such as, mountain gorilla, African elephant, two-horned rhino, giraffe, aardvark, numerous lemurs and many civets.

5. Oriental Realm

Political Map of the World, June 1997



5. ORIENTAL REALM

Characteristics:

This region includes Indian sub-continent including Ceylon, Burma, Philippines, Formosa, Southern China and also the southern region Himalayas. On the West of it Arabian sea is present. In the South east true physical boundary is absent. This region shows tropical and temperate zones. In the North East Asia, tropical rain forest is present, but towards the west there is desert. The remaining part shows plains and rivers hence this region shows different types of atmospheric as well as environmental conditions. Hence the Realm is provided with very rich flora and fauna, showing different biodiversity hot spots.

Sub-Regions:

1. Indian sub-region,
2. Ceylon sub-region.
3. Indo-China sub-region,
4. Indo-Malayan sub-region.

Climate: Oriental Region is known for its varied physical features. The **northern** part of India is temperate, **eastern** part including Burma, Indochina, and North East Asia are rain forest. **Western** Peninsular part is desert and **southern** portion of Indian subcontinent has tropical forests. Similarly Ceylon (Sri Lanka), Indochina and Malaysia contain thick forests. The Himalaya becomes drier and less hospitable westward. The climate of Oriental Region varies. In southern part of the Oriental Region temperature is almost constant all year round and seldom higher than 30 C. in northern part there are great fluctuations varying 10-20 C, raising in spring and summer up to 30 C in the western and eastern western parts. The cool season is accompanied by drought. The hot season is moist. In the southern part the season is dry but with some rain on the mountains. The climate is generally moist, tropical rain deserts extend in the south. The northern countries contain grassy plains with scattered trees or bushes.

FAUNAL CHARACTERISTICS OF ORIENTAL REALM

Fishes in oriental region:- Fish fauna of Oriental region will resemble that of Ethiopian region. Oriental fish fauna is dominated by Carps and Cat fishes.

1. Notopteridae, 2. Anabantidae, 3. Syngnathus, 4. Cypsilurus etc.,

Amphibians in oriental region:- Tailed Amphibians are very rare, only one genus is represented *Tylotriton verrucosus*. Anura and Apoda Amphibians are more.

1. Rana species, 2. Hyla, 3. Rhacophorus, 4. Bufo, 5. Discoblastidae, 6. Ichthyophis, 7. Uraeotyphlus, 8. Gegenophis etc.

Reptiles in oriental region:- Many reptiles are seen in this region. This fauna is dominated by lizards, snakes, turtles and Crocodiles.

1. *Gavialis* 2. *Gekko* (Flying Lizard), 3. Chameleon 4. Varanus (Indian Monitor Lizard) 5. Python, 6. *Typhlops* 8. *Testudo* 9. Cobra etc., In this region Xenopeltidae, Uropeltidae forms are exclusive.

Birds in oriental region:- In this region 66 families of Birds are included.

1. Honey Guides, 2. Wood Pecker, 3. Horn bill, 4. Pea-cock etc.

Mammals in oriental regions:- This region includes 30 mammalian families.

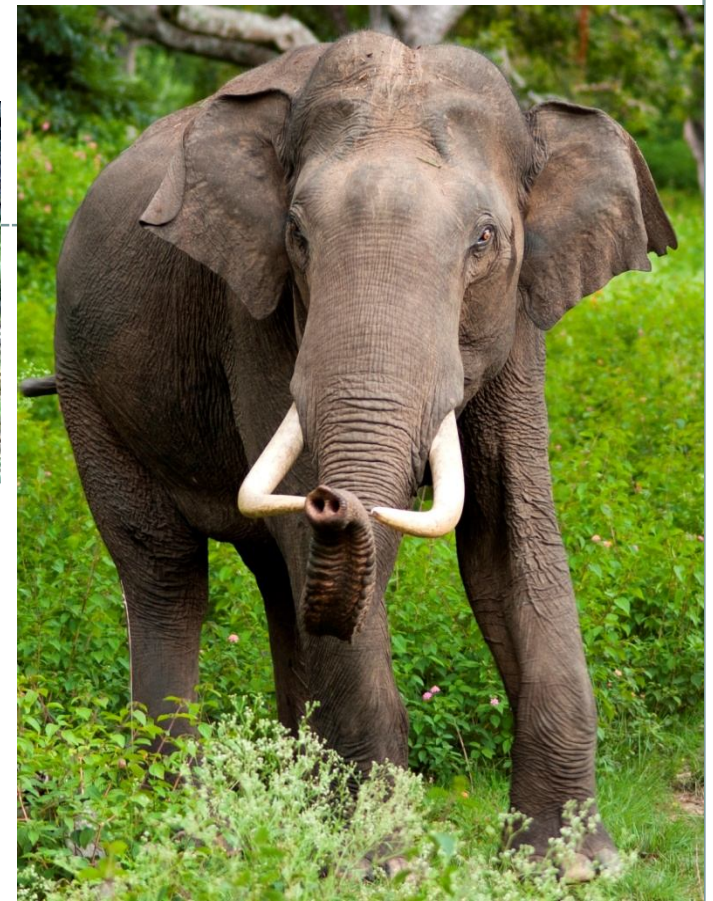
1. Shrews, 2. Rabbit, 3. Canis, 4. Cat, 5. Aye-aye (Hyaena), 6. Sues, 7. Equas 8. Rhinoceros, 9. Great apes like Orangutan, Gibbon Gorilla, Chimpanzee Alirus (Himalayan Pander) 10. Camel etc.,

In this region tree Shrews, flying lemurs, Indian Bisons are exclusive.

Various animals of Oriental Realm in COLLAGE

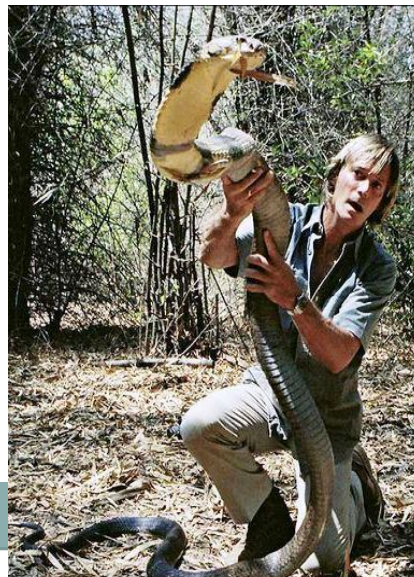


Some of Asiatic Fauna



Oriental Fauna

50 mammal families, such as, Malay tapir, Indian tiger, Water buffalo, Indian elephant, Red panda, King cobra.



Mammals of Oriental region



Indian Bison,
Tarsier, Tree
Shrews, Sunda
(Malayan) flying
lemur, Indian giant
flying squirrel are
exclusive animals.

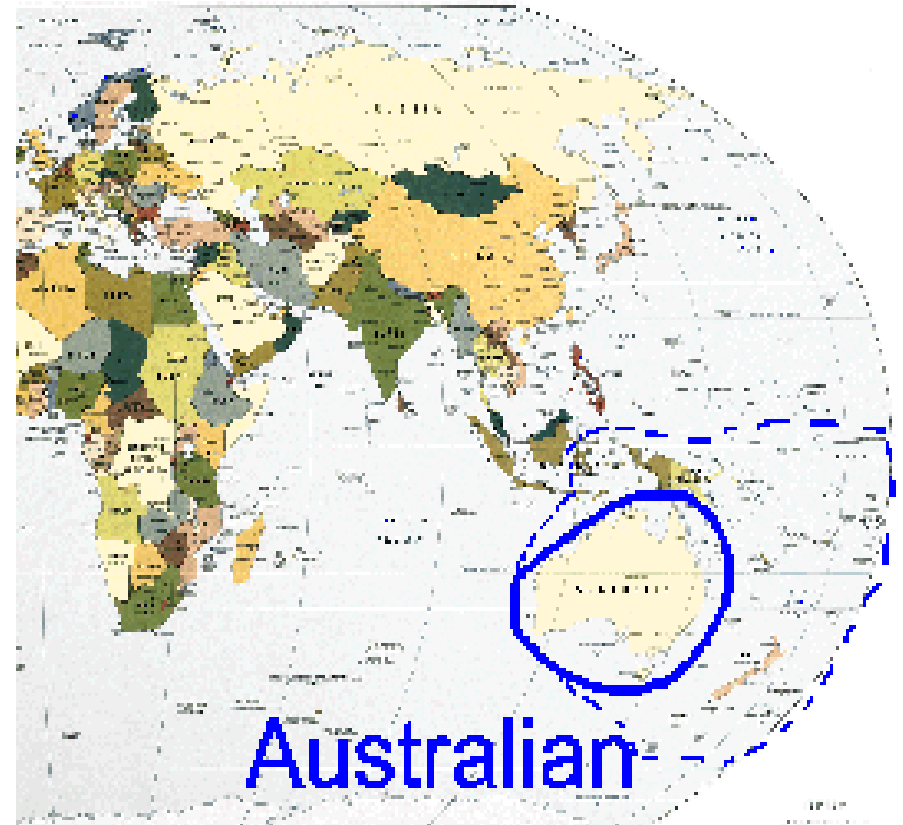


The Sunda Flying Lemur (*Galeopithecus variegatus*), also known as the Malayan Flying Lemur or Malayan Colugo, is a species of colugo found throughout South-East Asia.



6. Australian Realm

Australia and New Zealand have flora and fauna that are found nowhere else on Earth. Australia is distinctive because it is an island, a country, and a continent—the smallest of the world's continents. No other land mass can concomitantly make those three claims. Australia consists of a large mainland and the island of **Tasmania** to the south. The main physical area of New Zealand, on the other hand, consists of two main islands separated from Australia's southeastern region by the **Tasman Sea**. Australia is surrounded by various seas. The Indian Ocean surrounds its western and southern coasts. Indonesia and Papua New Guinea lie to the north, separated by the **Timor Sea** and the **Arafura Sea**. The **Gulf of Carpentaria** distinguishes **Cape York**, which extends north along Australia's eastern coast almost to Papua New Guinea. The **Great Barrier Reef** runs for more than 1,600 miles off the continent's northeastern shores. The **Coral Sea** separates the Great Barrier Reef from the South Pacific. The southern side of Australia is the **Great Australian Bight** and the island of Tasmania. Bight is a large and wide bay. To the south of Australia and New Zealand is Antarctica. The two countries have distinct physical geographies.



The **fauna of Australia** consists of a huge variety of animals; some 83% of mammals, 89% of reptiles, 24% of fish and insects and 93% of amphibians that inhabit the continent are endemic to Australia.

AUSTRALIAN REALM

Characteristics:

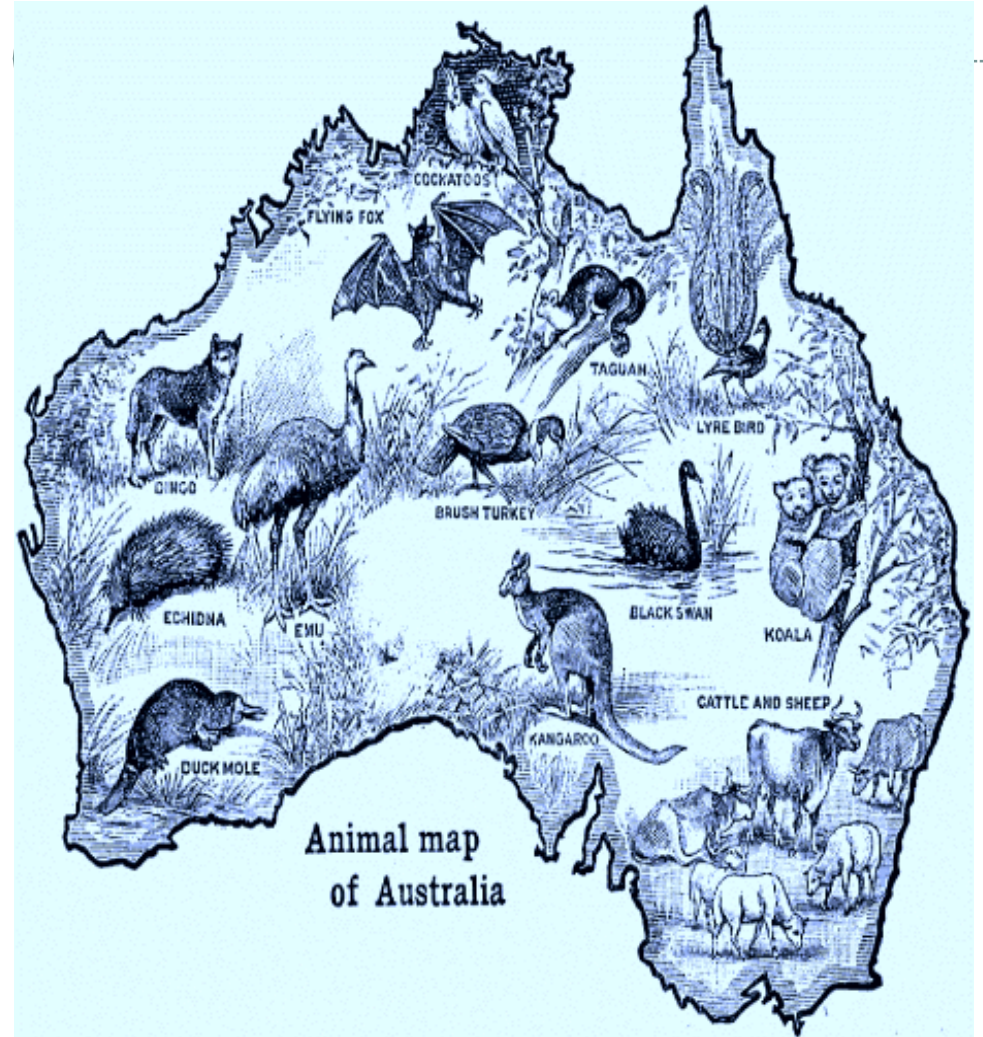
This region includes Australia, Tasmania, New Guinea, and a few smaller islands of the Malay Archipelago. But some experts have excluded New Zealand and the Pacific Islands, for these are regarded as oceanic islands separate from the major faunal regions. Partly tropical and partly south temperate, the Australian region is noted for its lack of a land connection with other regions; the poverty of fresh water fish, amphibians and reptiles; the absence of placental mammals and dominance of marsupials.

Sub-Regions:

- a) Australian subregion.
- b) Austromalayan Subregion.
- c) Polynesian Subregion.
- d) Newzealand Subregion.

Climate: Australia is relatively flat with low elevation highlands and an extensive dry interior, while New Zealand has high mountains and receives adequate rainfall. The tropical **regions** of **Australia**, in the north of the country, including the equatorial and sub-tropical zones have high **temperatures** and high humidity and distinct wet and dry seasons. In the **Australian** tropics the wet season, called the monsoon season, lasts about six months, between November and March. Both hot and temperate (cold) climates exist in this region. Average annual rain fall is about 75mm. Rain forest, grass land, eucalyptus forest are prominent ecological conditions of Australian Realm.

Exclusive animals are the egg-laying mammals (monotremes) *Ornithorhynchus anatinus* (platypus or duck mole) and the spiny ant-eaters *Zaglossus hrujini* & *Tachyglossus aculeatus* (echidna, spiny ant-eater). The characteristic fauna of this region also include species: *Neoceratodus* (lung-fish), *Chelmon rostratus*, *Phyllopteryx eques*, etc. Important marsupials are *Macropus giganteus* (kangaroo), *Notoryctes typhlops*, *Macrotis lagotis*, *Dumaius novaehollandiae*, *Petaurus australis*, *Paradisaea rubra*, *Pteridophora alberti* and (koala). Endemic birds are *Abertis owenii haasti* (kiwi) etc. Antarctic region has the following characteristic animal species: *Balaenoptera musculus* (blue whale), *Orcinus orca*, *Megadyptes antipodes*, *Aptenodytes patagonica* (penguin), *A. forsteri* (Emperor penguin), *Pygoscelis adeliae*, *Diomedea exulans* (albatross), *Chionis alba* etc.



Few Representatives of Australian Realm



Kangaroo, Wombat, Cassowary,
Sugar glider, Echidna & Koala.

FAUNAL CHARACTERISTICS OF AUSTRALIAN REALM

Fishes: In this region the most important fish is a lung fish. *Neoceratodus* is seen in this region. It is called “**Australian Lung Fish**”. Osteoglossids & Gadopsids are other important fishes.

Amphibia: Notable amphibians are *Pseudophryne*, *Pachybatrachus*, *Heliophryniscus*, *Pelodytes* and Leptodactylids. New Guinea includes only Xenorhinae.

Reptilia: Out of 31 families, 4 are endemic, such as, Pyzopodiidae, Aprasiidae, Laliidae, and Dermocheliidae. N. Zealand possesses Rhynchocephaliidae comprising the lone survivor *Sphenodon*. Others are *Varanus* (Monitor Lizard), *Trionyx*, *Testudo elegans*, *Caretta caretta*, *Chamaeleon*, *Calotes versicolor*, *Mabuya* etc.

Aves: In this region flightless birds are common, such as *Apteryx mantelli* (Kiwi, is present only in Newzealand), *Dromaius novaehollandiae* (Emu) in New Guinea, and three spp. of Cassowaries eg. *Casuarius casuarius*, *C.bennetti* & *C. unappendiculatus*. The other birds can be seen in this region are Pigeon, Duck, Crane, Crow, *Passer domesticus* (Sparrow), etc.

Mammalia: Three spp. of prototherians (Monotremata) are Duck-billed Platypus (*Ornithorhynchus anatinus*) & Echidna or Spiny ant eaters (*Zaglossus bruijnii*, *Z. bartoni* , *Z. attenboroughi* & *Tachyglossus aculeatus*). About 234 Marsupials occur in Australia, and these are Kangaroos (*Macropus rufus*) & Wallabies (*Lagostrophus fasciatus*), Wombats(*Vombatus ursinus*), Koalas (*Phascolarctos cinereus*) Tasmanian Devils, (*Sarcophilus harrisii*) Opossums (*Didelphis virginiana*) and Gliders (*Petaurus breviceps*, Sugar glider).

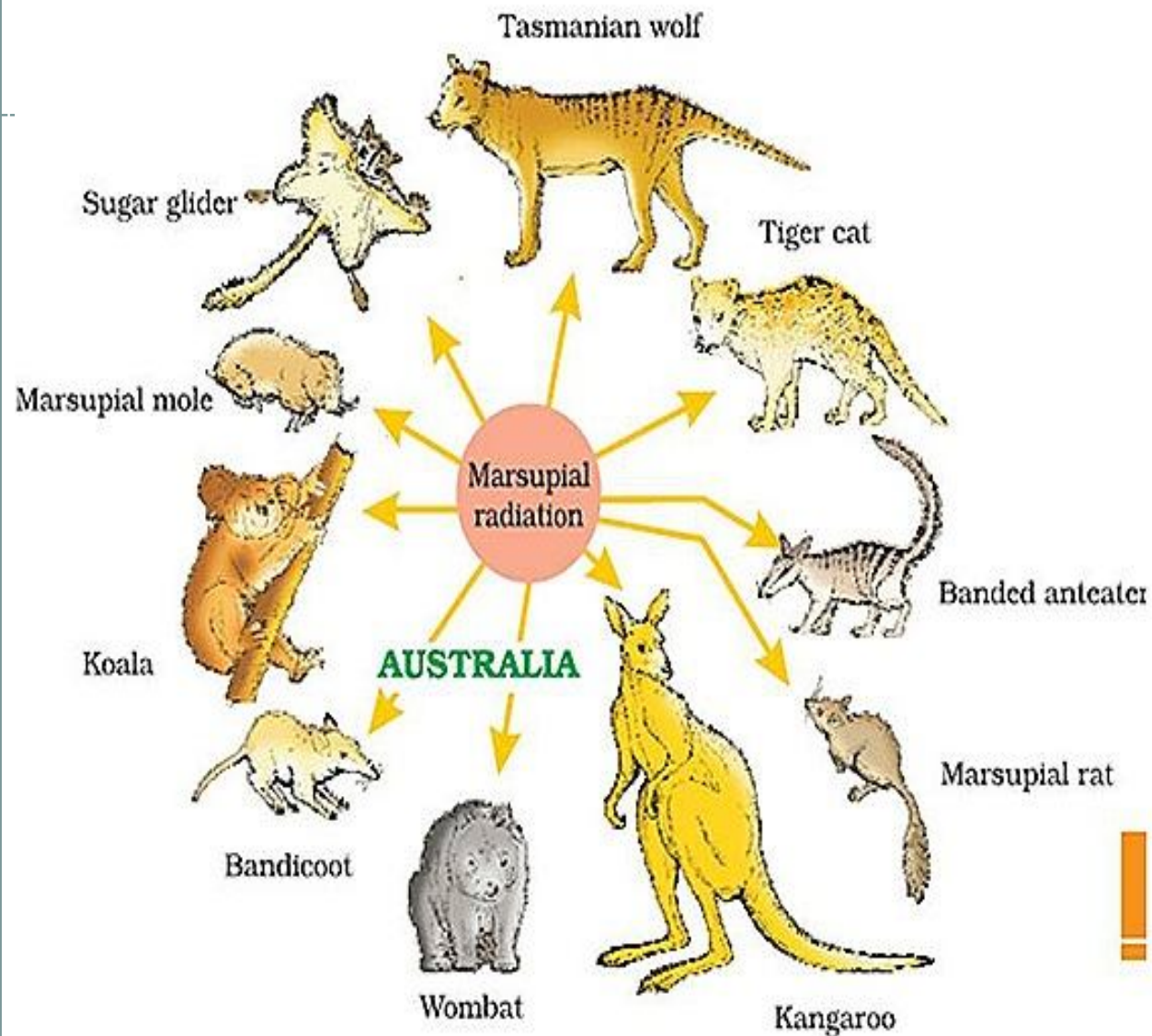
NOTE: Australia has indigenous placental mammals from two orders: the [bats](#), order Chiroptera, represented by six families, and the mice and rats, order [Rodentia](#), family [Muridae](#). Bats and rodents are relatively recent arrivals to Australia. Bats probably arrived from Asia, and they are present in the fossil record only from as recently as 15 MYA. Although 7% of the world's bats species live in Australia, there are only two endemic [genera](#) of bats. Rodents first arrived in Australia 5–10 MYA and underwent a wide radiation to produce the species collectively known as the "[old endemics](#)" rodents. The old endemics are represented by 14 extant genera. About a million years ago, the rat entered Australia from [New Guinea](#) and evolved into seven species of *Rattus*, collectively called the "[new endemics](#)."

Since human settlement, many [placental](#) mammals have been introduced to Australia and are now [feral](#). The first was the [dingo](#); fossil evidence suggests that people from the north brought the dingo to Australia about 5,000 years ago.^[6] When Europeans settled Australia they intentionally released many species into the wild, including the [red fox](#), [brown hare](#), and the [European rabbit](#). Other domestic species have escaped and over time have produced wild populations including the [cat](#), [fallow deer](#), [rusa deer](#), [chital](#), [domestic horse](#), [donkey](#), [pig](#), [domestic goat](#), [water buffalo](#), and the [dromedary](#). Only three species of Australia's non-indigenous placental mammals were not deliberately introduced: the [house mouse](#), [black rat](#) and the [brown rat](#).

Few Representatives of Australian Realm

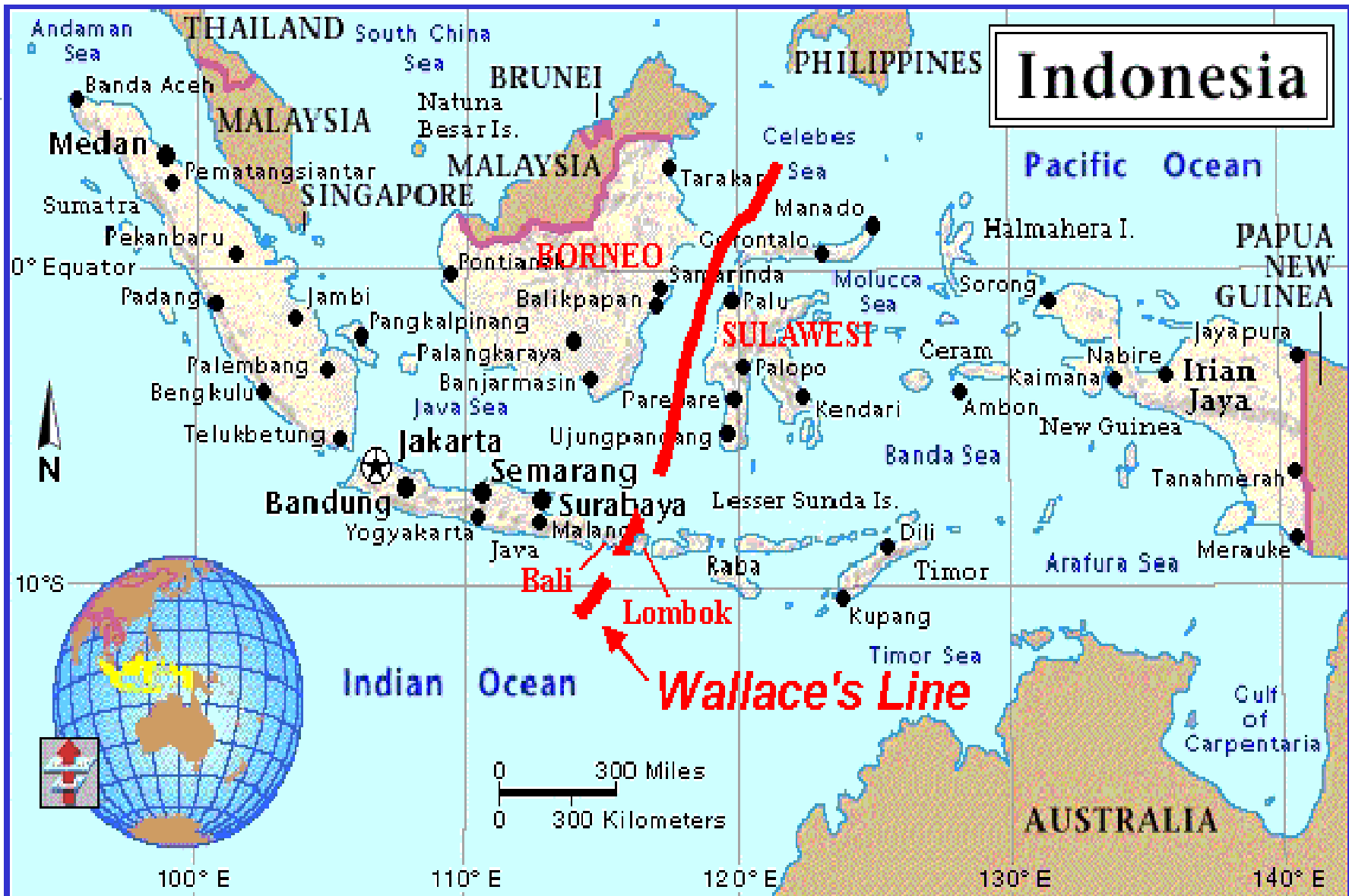


Biliby, Duckbill, Quoll, Tasmanian Devil, Tuatara (Sphenodon)

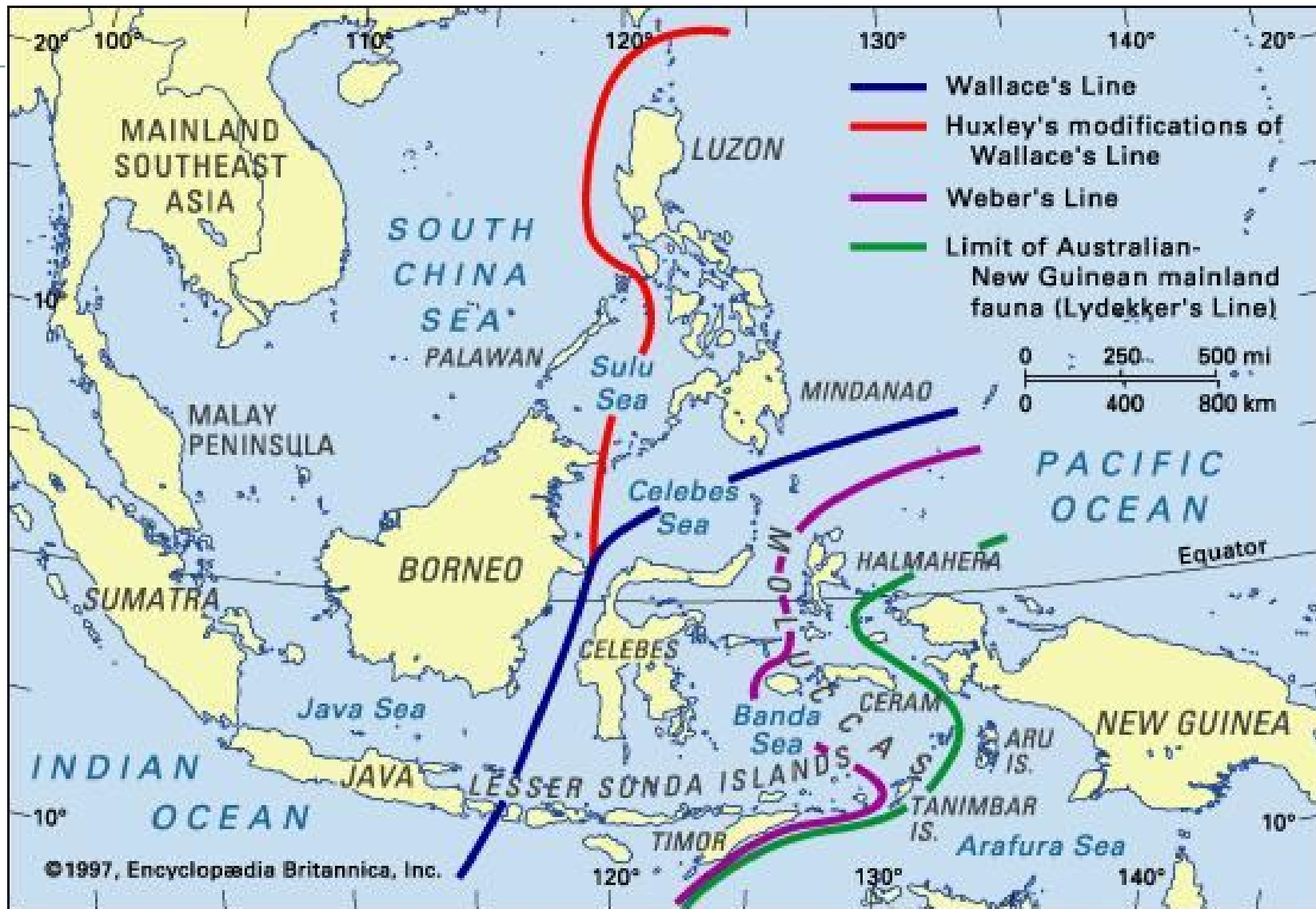


NOTE: Close to 70% of the 334 extant species occur in the Australian continent (the mainland, Tasmania, New Guinea and nearby islands) with the remaining 100 found in the Americas, primarily in South America, but with thirteen in Central America, and one in North America north of Mexico.

Indonesia



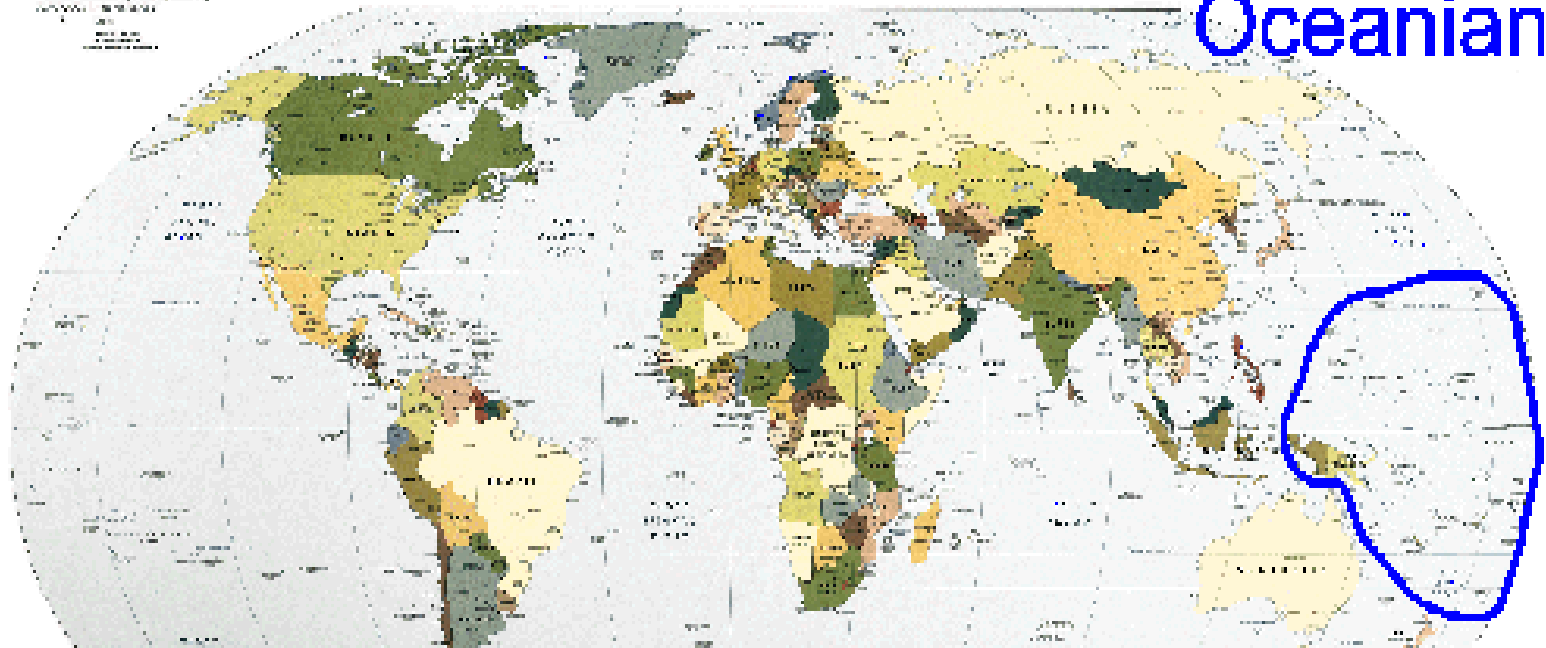
4-Lines of Austro-Oriental Junction (Transitional Regions)



The 7th Realm is Oceanian Realm (New Inclusion by some)

World
Map
of
Biogeographic
Realms
June 2007

Oceanian



1. SINDHUGHOTAK/ WALRUS: 2 types

Atlantic walrus, *Odobenus rosmarus rosmarus*

Pacific walrus, *Odobenus rosmarus divergens*

2. Maui's dolphin or **popoto** (*Cephalorhynchus hectori mauī*) is the world's rarest and smallest known subspecies of [dolphin](#).

3. Seal of New Zealand: [Arctocephalus forsteri](#)

4. Antarctic Krill: *Euphausia superb*

5. Penguins: Of the 17 species under 6 genera: [Aptenodytes](#), [Eudyptes](#), [Eudyptula](#), [Megadyptes](#), [Pygoscelis](#), [Spheniscus](#), only six are found in Antarctica (Adélies, Chinstraps, Emperors, Gentoos, Macaronis, and Rockhoppers)

Mammals of Oceanian Realm



Marine mammals

- Walrus
- Dolphins
- Whales
- Seals
- Krills



CONTINENTAL DRIFT THEORY

**PAST
&
PRESENT**

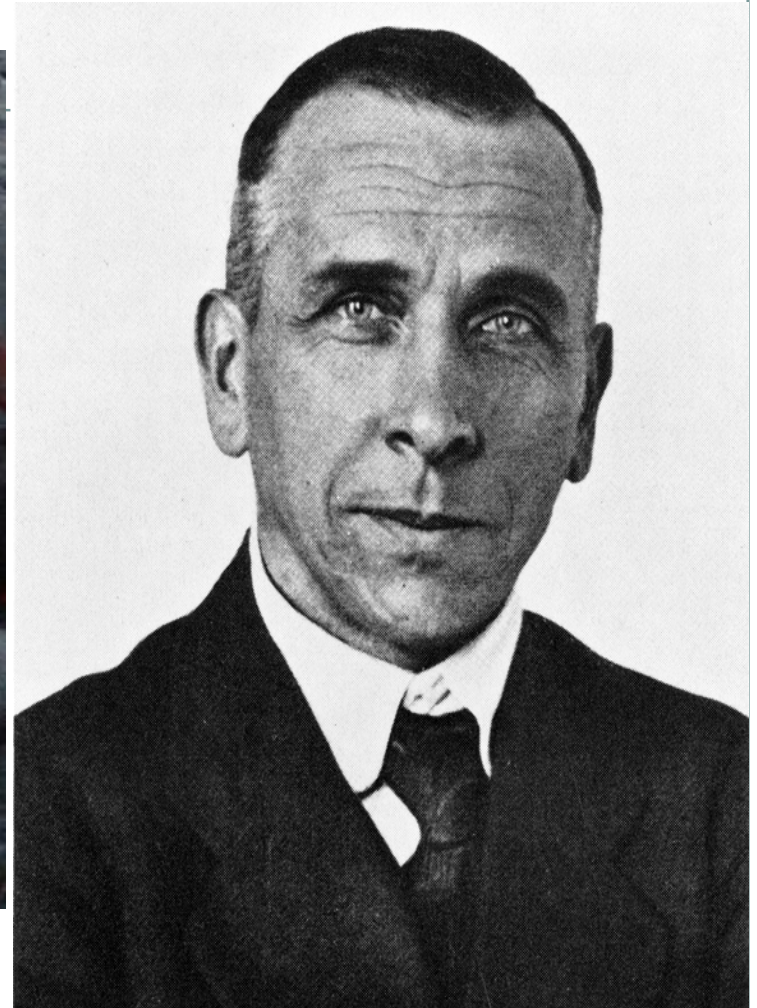
Alfred Wegener: *The Origins of Continents and Oceans*



Alfred Lothar Wegener (1 November 1880 - ? November 1930) was a German polar researcher, [geophysicist](#) and [meteorologist](#). During his lifetime he was primarily known for his achievements in meteorology and as a pioneer of polar research, but today he is most remembered as the originator of the theory of [continental drift](#) by hypothesizing in 1912 that the [continents](#) are slowly drifting around the Earth (*Kontinental verschiebung*). His hypothesis was controversial and not widely accepted until the 1950s, when numerous discoveries such as [palaeomagnetism](#) provided strong support for continental drift, and thereby a substantial basis for today's model of [plate tectonics](#).



Cold rock on top; hot, liquid rock underneath.....Wegener , unfortunately, missed to locate as a solid evidence in favour of his HYPOTHESIS/THEORY



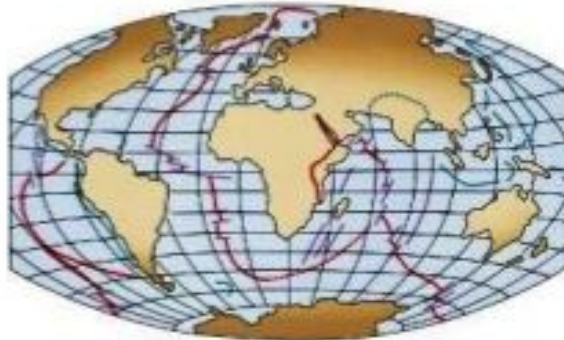
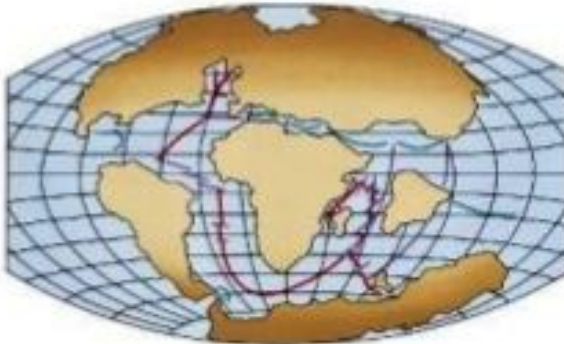
Alfred Wegener (1880-1930)

Alfred Wegener

- Alfred Wegener was a German scientist who formed the **Theory of Plate Tectonics** and proposed the idea of **continental drift**
- This theory states that Earth is broken into several **plates that are constantly moving** and drifting, resulting in changes to the earth



Theory of Continental Drift



- The Theory of Continental Drift is an early predecessor of the Theory of Plate Tectonics and states that all present continental masses were once connected as single land unit called Pangaea. Pangaea subsequently broke apart with each segment drifting to its present location.

- The major weakness of the theory was the lack of a plausible driving mechanism to explain why the continents had drifted.

Continental drift: an idea before its time

Wegener's continental drift hypothesis

- Evidence used by Wegener
 - Fit of South America and Africa
 - Fossils match across the seas
 - Rock types and structures match
 - Ancient climates
- Main objection to Wegener's proposal was its inability to provide a mechanism

Continental Drift: An Idea Before Its Time

- **Alfred Wegener**
 - **First proposed his continental drift hypothesis in 1915**
 - **Published *The Origin of Continents and Oceans***
- **Continental drift hypothesis**
 - **Supercontinent called *Pangaea* began breaking apart about 200 million years ago**

Wegner's Evidence of Continental Drift

1. Fossil Evidence
2. Rock formations
3. Climatic Evidence
4. Geographic Evidence

REJECTED!!!

- Scientists rejected Wegener's theory of continental drift
- Most scientists in the 1900's believed the Earth was cooling & shrinking causing the continents to move & mountains to form

The theory of continental drift, stated by Wegner, a German meteorologist, says that Earth once had a single landmass that broke up into pieces, which have since drifted apart.

Scientists call this giant landmass, Pangaea, which means all Earth.

Wegener's problem

He could not find the force that was causing the continents to drift.

Because of this, he could not convince anyone that continents could move.

He died in Greenland on an expedition.

At the time of his death, no one believed his hypothesis!

Technology developed during the 1940's changed all that!

Wegener's Problem

- No mechanism to cause continental drift
- Proposed continents were moving through the ocean's crust by centrifugal and tidal forces
- If so, continents would be deformed
- There isn't enough force from either to move continents
- His theory was not accepted until after his death

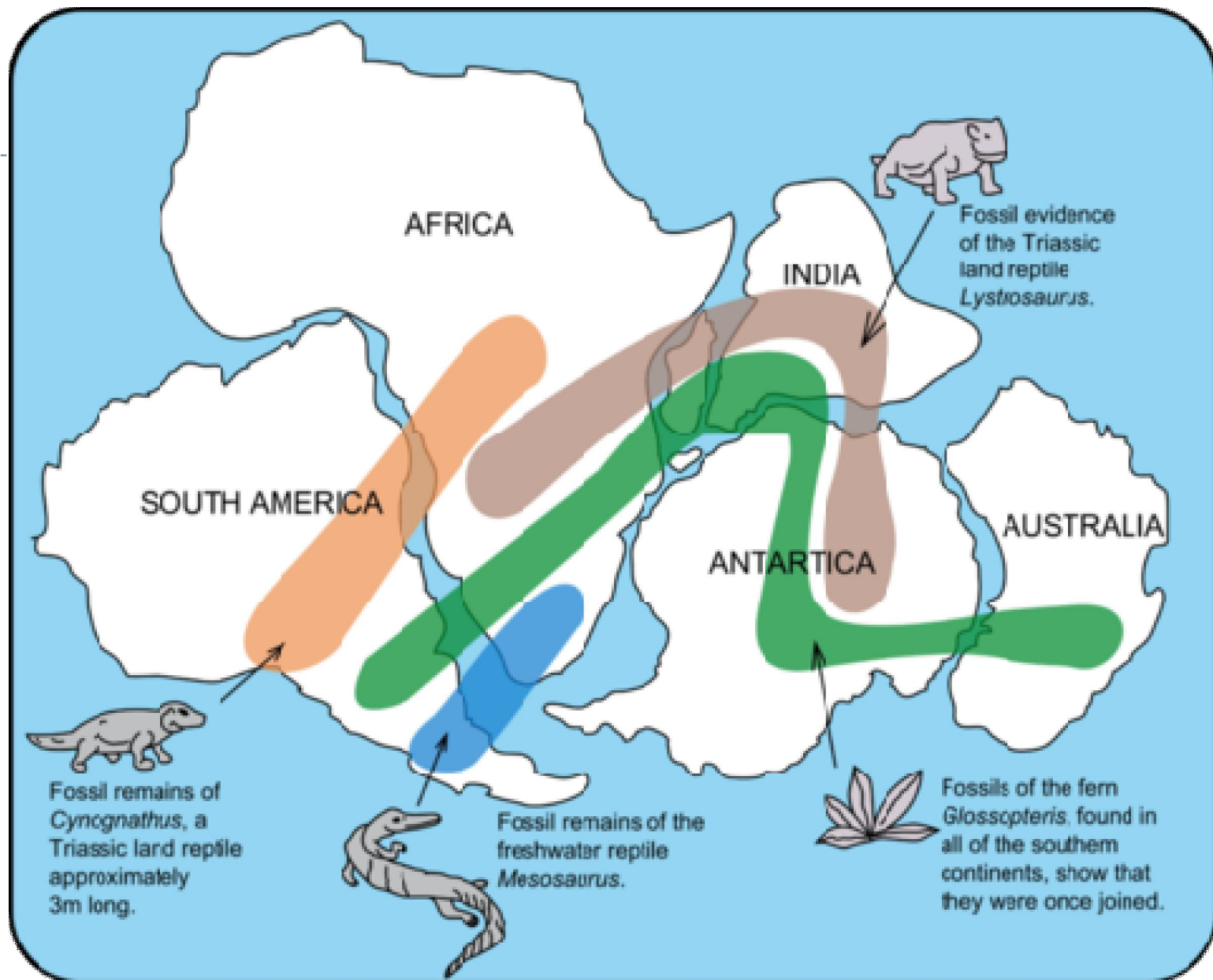
Plate Tectonics

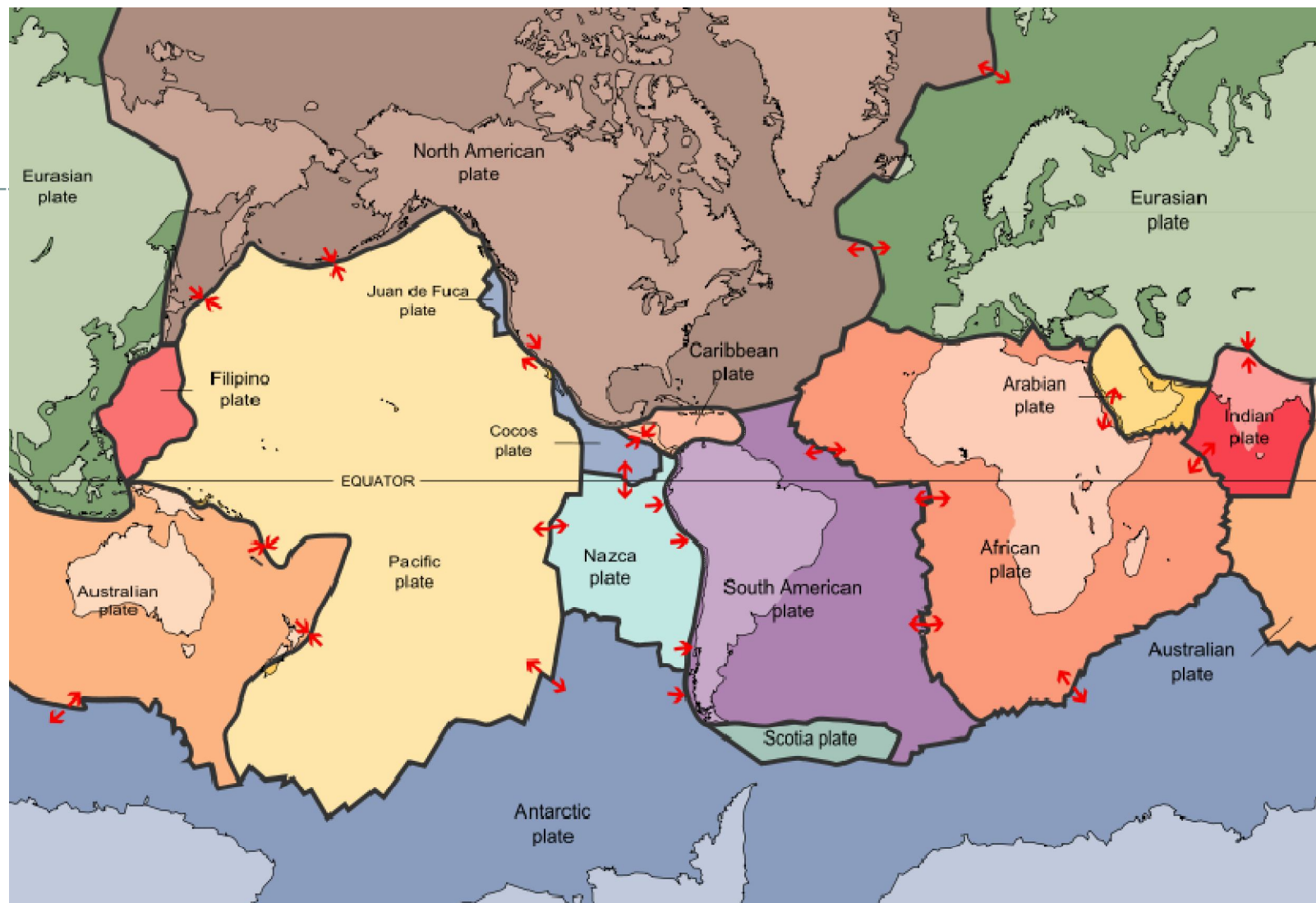
1912: Alfred Wegener's theory of continental drift

(Wegener did not explain how continents could move)

Arthur Holmes explained how continents ride on convection currents in the mantle and move

Ocean bathymetry (depth measurement) and magnetic field reversal data in oceanic crust provided evidence of sea floor spreading (but without a time scale) in the 1950s and 1960s





The tectonic plates of the world were mapped in the second half of the 20th century.

MAJOR TECTONIC PLATES OF THE EARTH





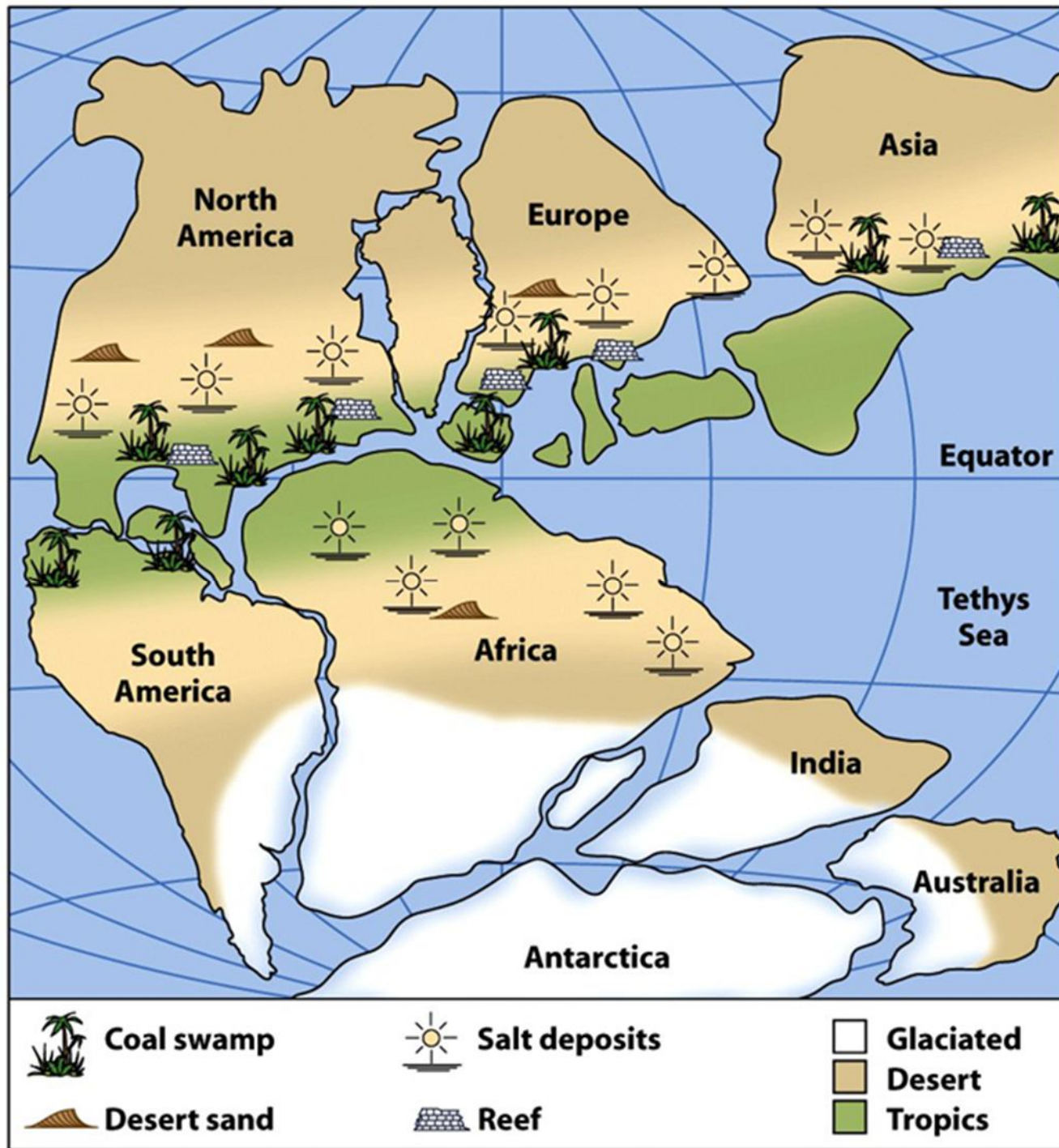
What is the evidence for continental drift?

If the continents moved closer then they would fit together like a jigsaw puzzle and was once called Pangea.

Living animals in largely separated lands have similarities like India and Madagascar have similar mammals even though they are far apart from each other.

Fossils have been found on either of an ocean.

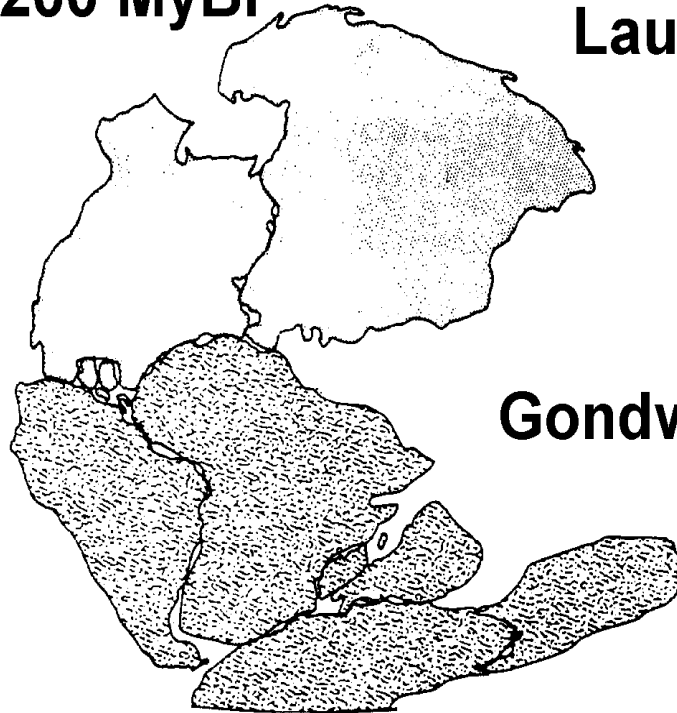




Mapping of Salt deposits, Coal swamps, Sand deposits, Glacial fields & Coral reefs, along with Tropic zone formation, etc. indicate strong evidences in favour of PANGAEA of about 20 crores years back

Continental Drifting

200 MyBP



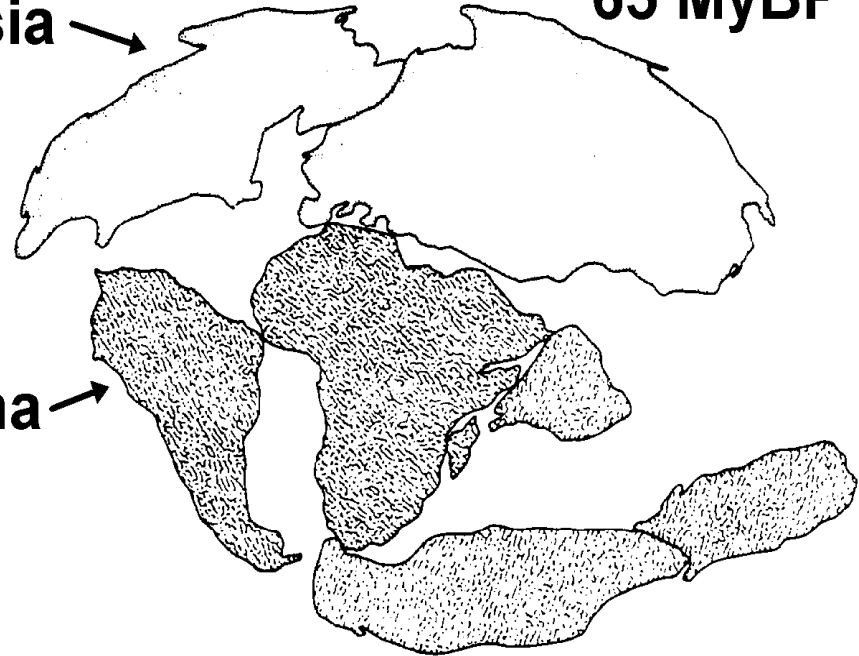
Pangaea

Triassic Period

Laurasia

Gondwana

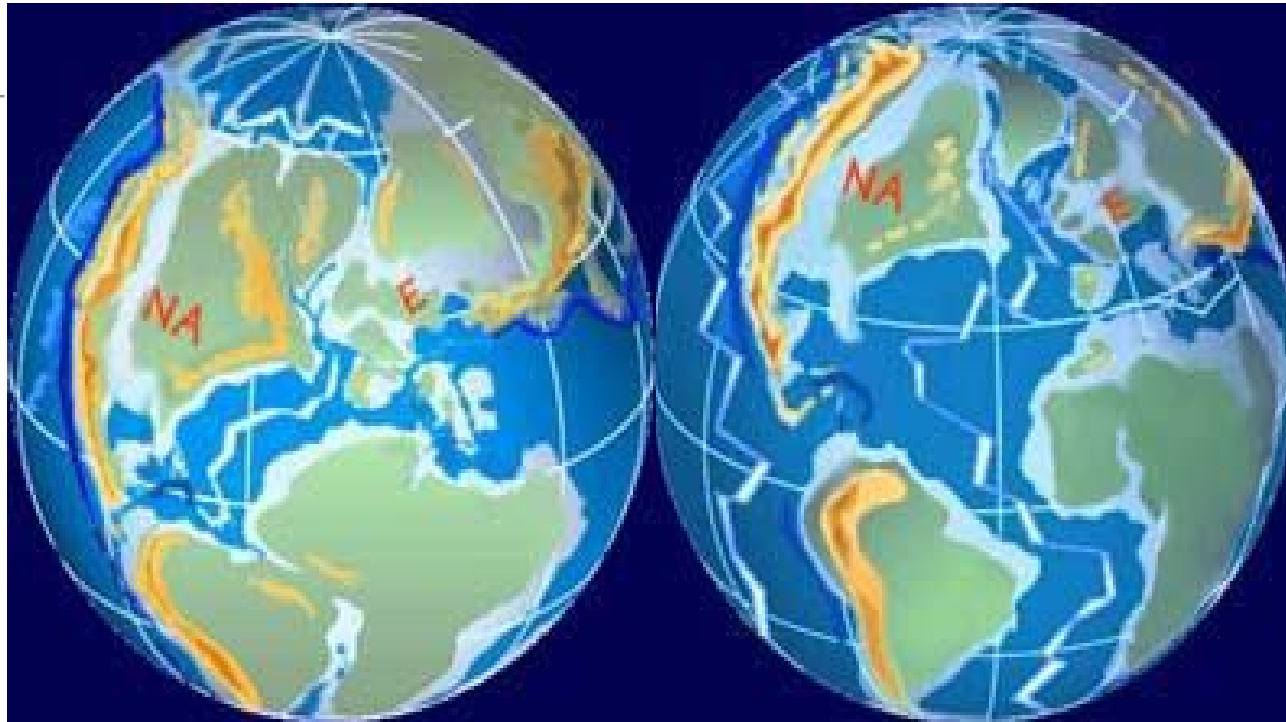
65 MyBP



Source: Vaughan, 1986, Mammalogy,
3rd edition, Saunders Publ.

Jurassic Period

Continental Drifting



**The Earth
during
Cretaceous
period**

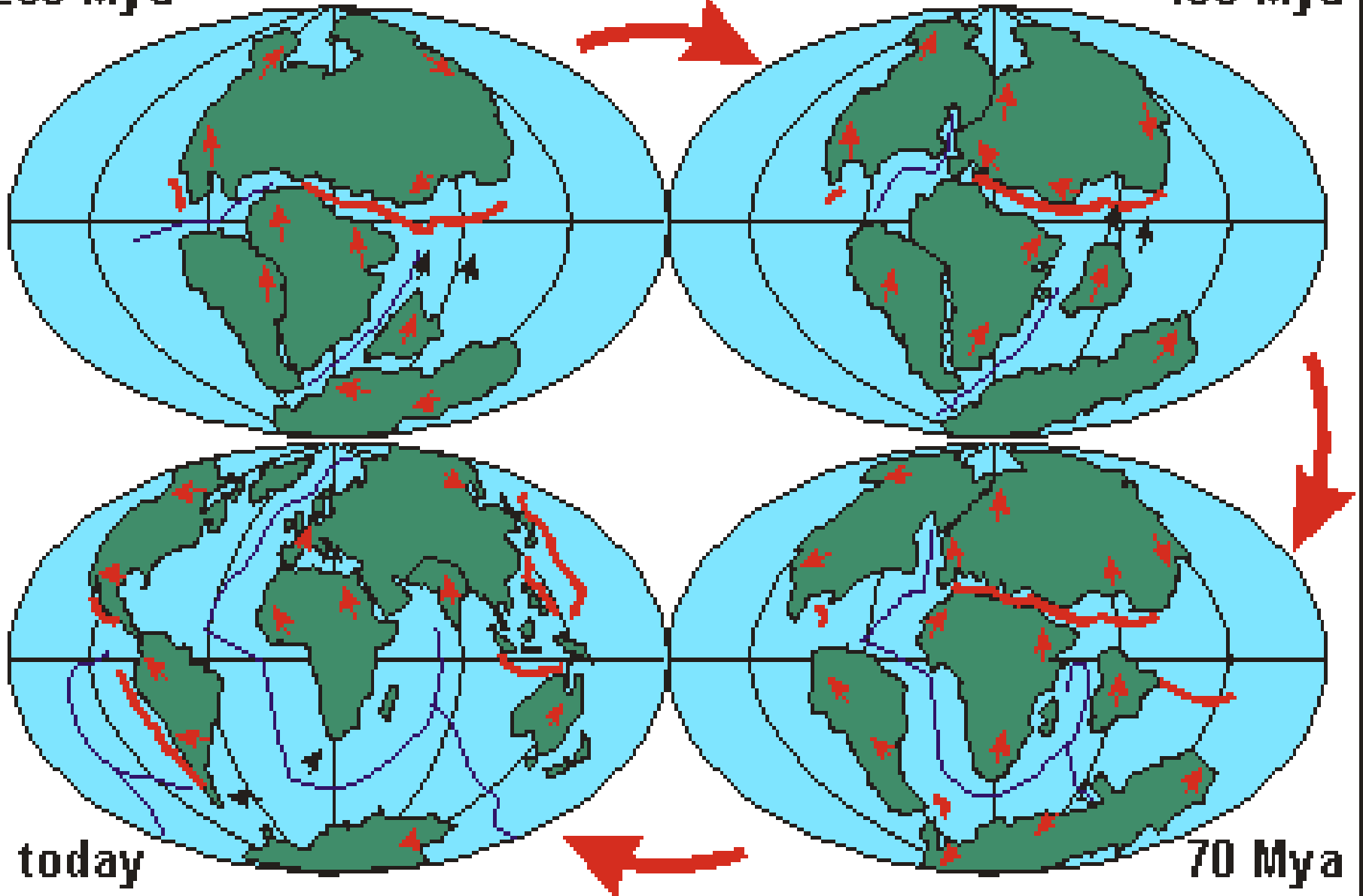
Sequence of Events:

- # End of Cretaceous Period = S. America drifts westward breaking from Africa
- # Cenozoic Era = continued drift yielding current continental spatial arrangement

continental drift

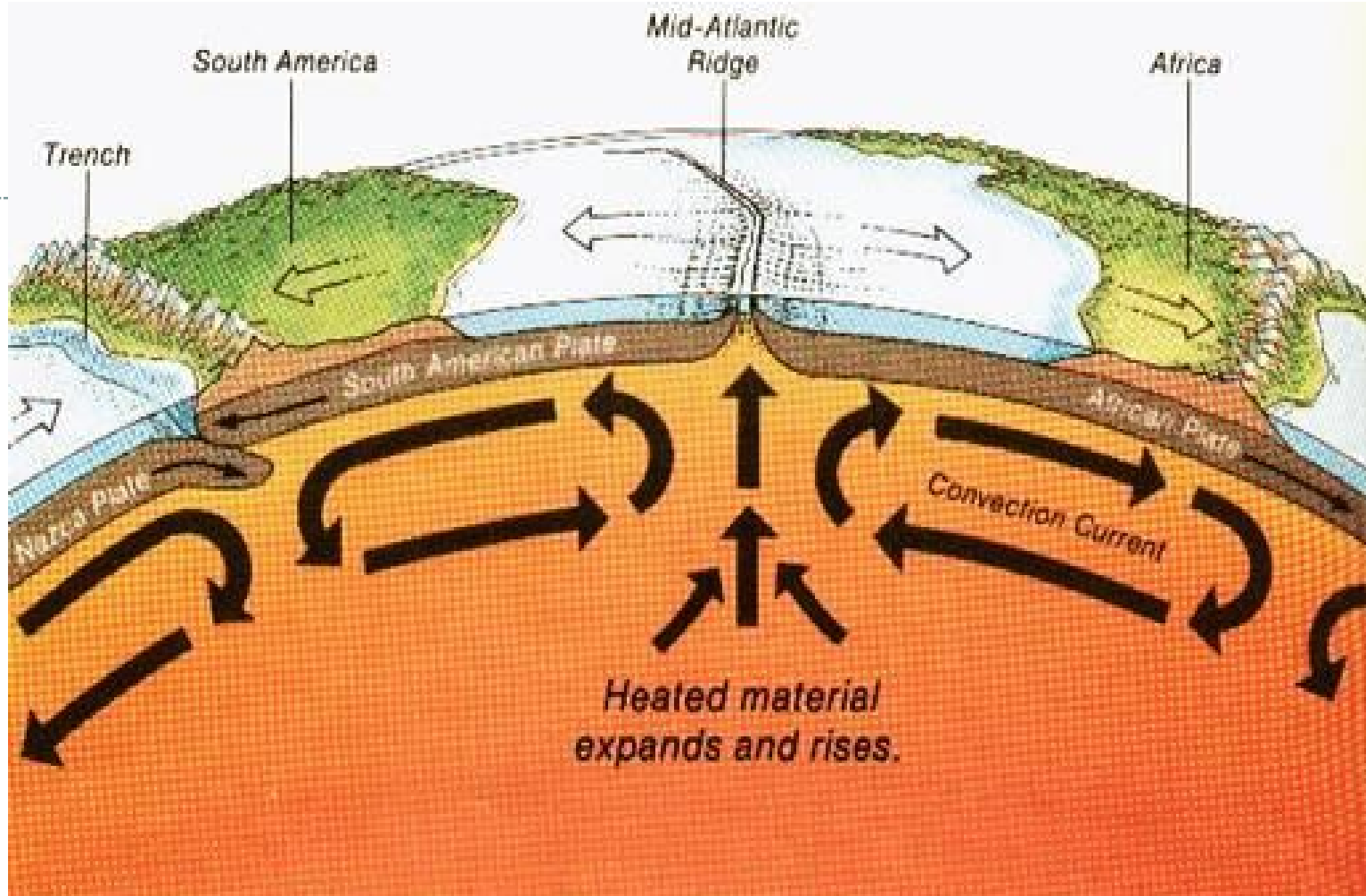
200 Mya

130 Mya

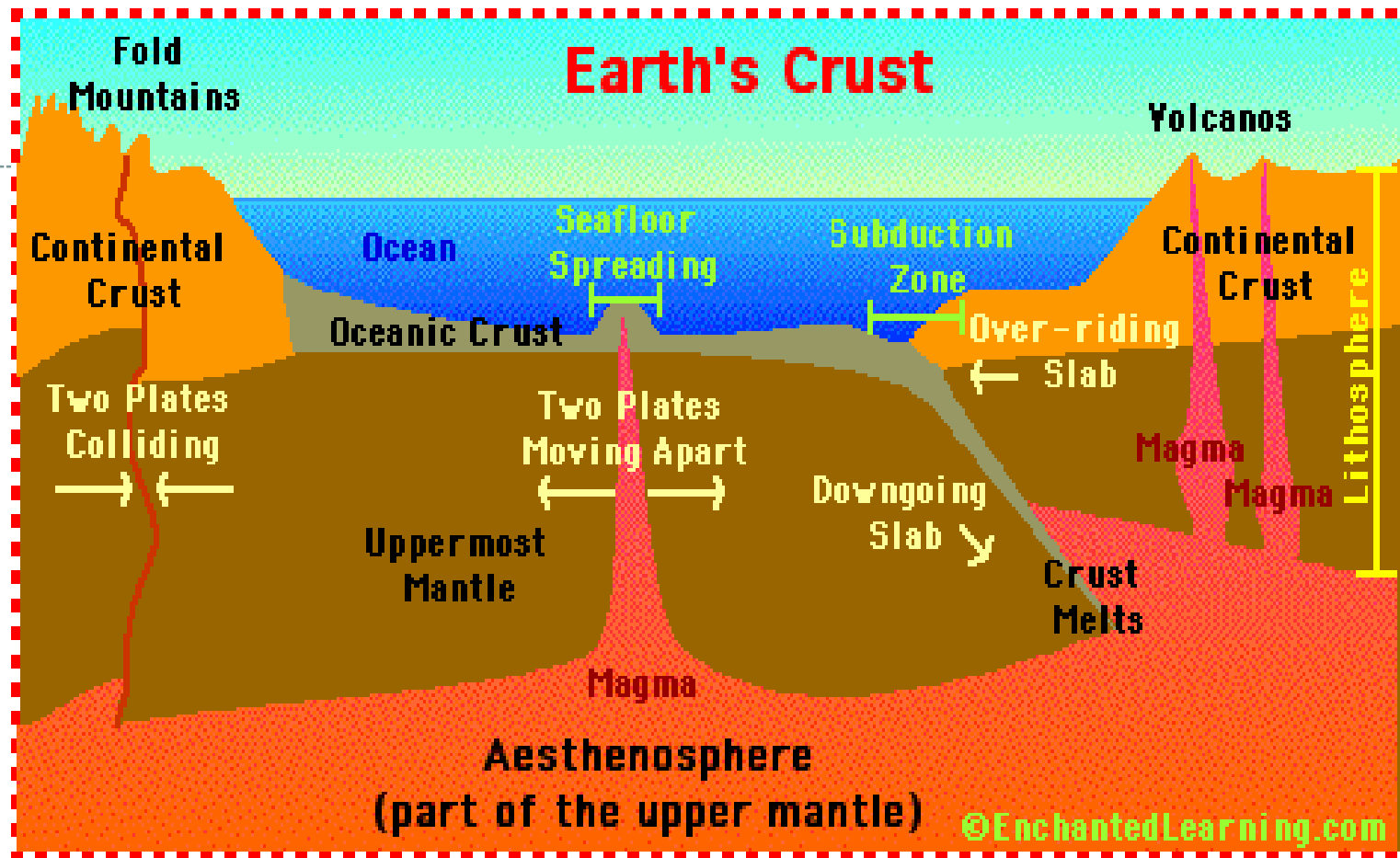


CAUSES OF PLATE MOTION

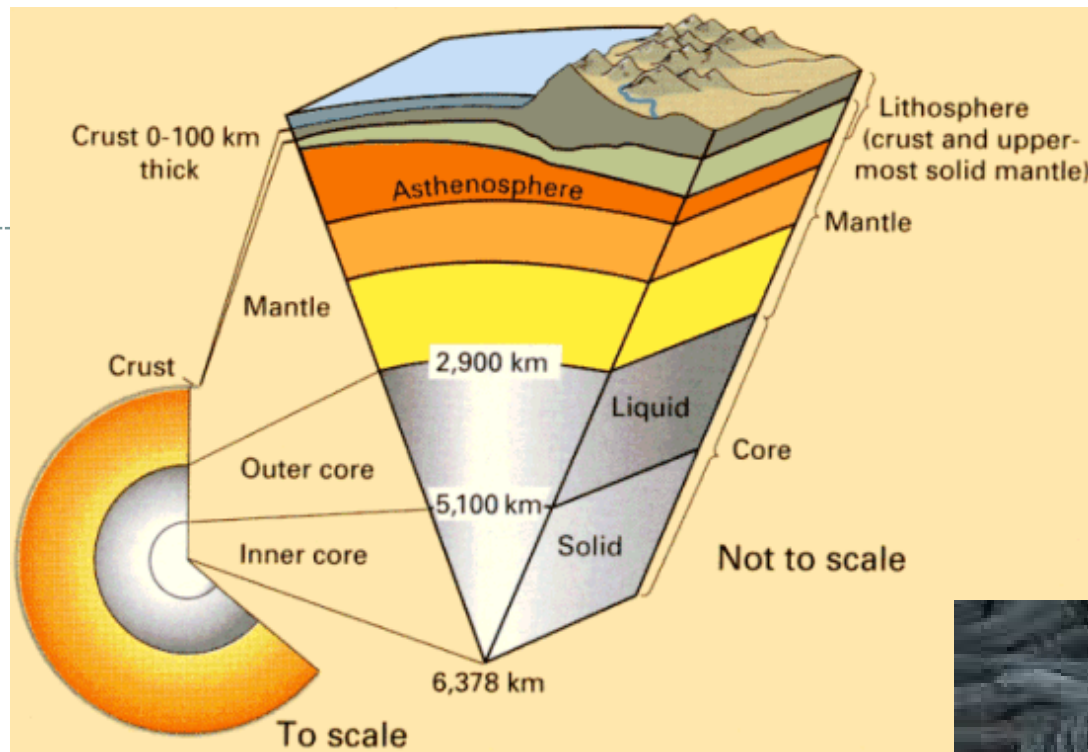
- Movement of tectonic plates is due to convection
- Convection- is the movement of heated material due to differences in density that are caused by differences in temperature
- This cycle of convection currents is called convection cell



Central to plate tectonics is the understanding of the linkage between seafloor spreading and currents of upwelling hot mantle rock that yield the molten rock that solidifies as new crust at the midocean ridges. The midocean ridge system is the main avenue for the release of heat from the interior of the Earth.



Upheaval of mountains is the result of continental collisions, such as the formation of the Appalachians when Pangea formed by the collision of Gondwana and Laurasia. Continental collisions are in turn the result of tectonic plate motions which result from seafloor spreading which releases heat from the Earth's interior.



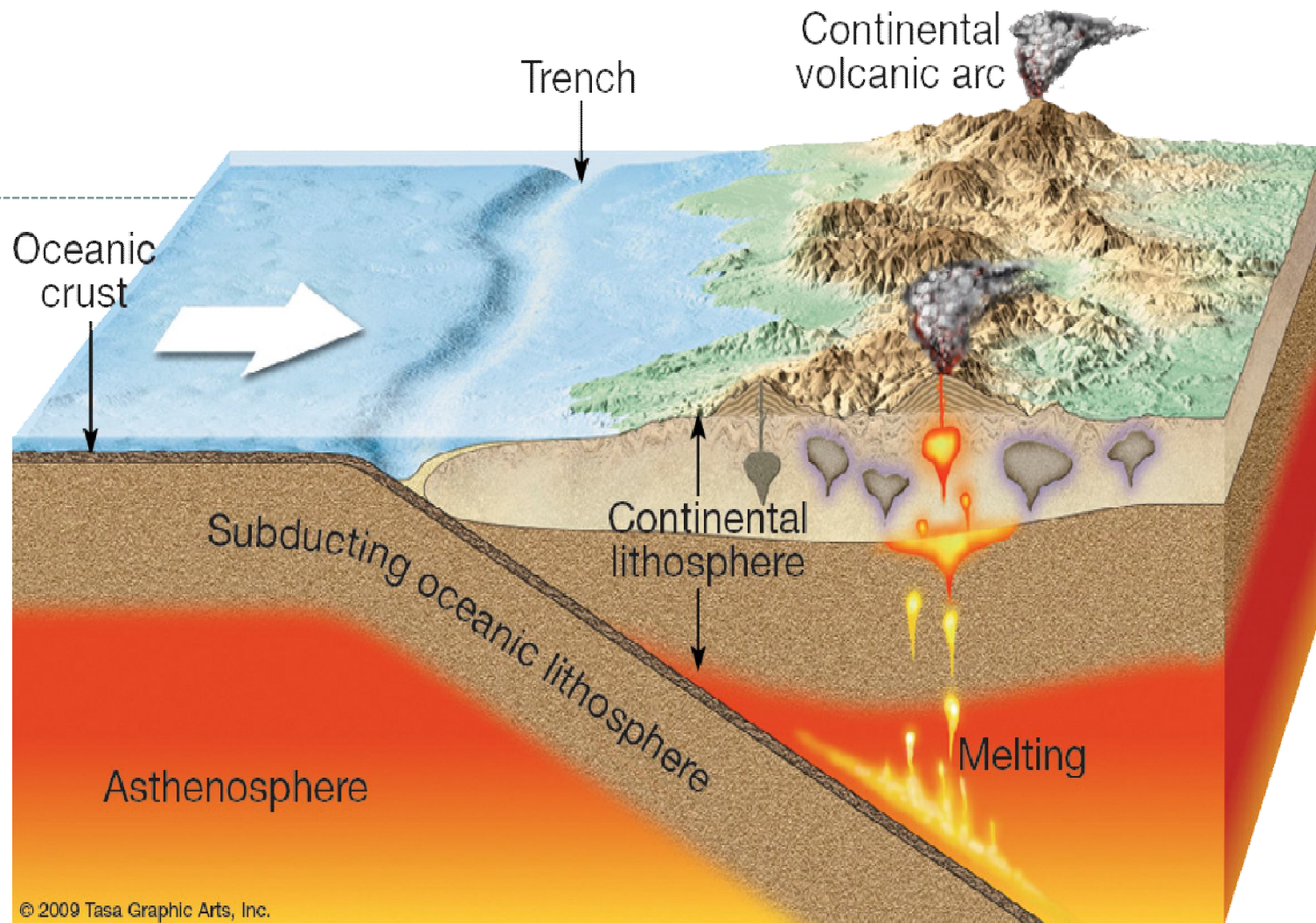
Compression in crust can make mountains. Extension can make cracks and valleys.



What caused (causes!) continental drift?

sea floor spreading moves tectonic plates of the earth's crust (lithosphere)



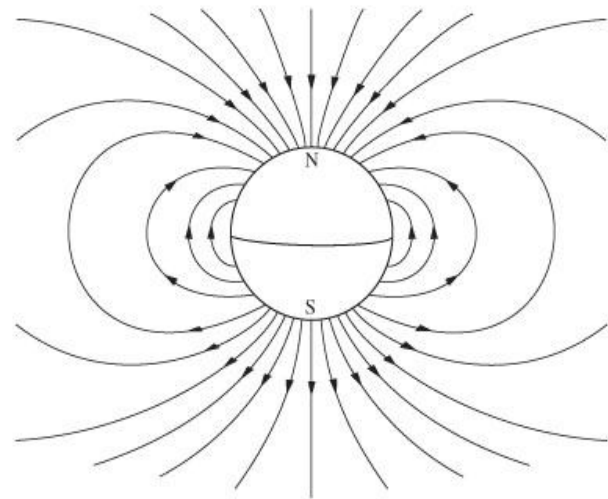


Continental Drift: How does it occur?

1. Convection currents cause upswelling of molten material to earth surface (e.g.ocean floor)
2. Form chains of underwater volcanic mts. ("spreading ridges")
3. New sea floor formed & pushed away from upswelling as new molten material appears
4. Magnetic polarity evidence



1. Continental margin-similarity-evidence (old)
2. Fossil similarity-evidence (old)
3. Folded rock evidence
4. Magnetic Field evidence
5. Mid-oceanic ridges-evidence
6. Mountain height increment –evidence
7. Volcanic eruptions & Earth quake-evidence
8. Spreading sea-floor-evidence





ANIMAL
DISTRIBUTION
&
BARRIERS
to
ANIMAL
DISPERSAL

PRINCIPLES OF ANIMAL DISTRIBUTION

Species of animals and plants show some well-known patterns of distribution, which have resulted from adaptations that they have acquired during evolution. Jordan and Kellogg proposed three laws that govern distribution and postulated that every species should be found everywhere unless:

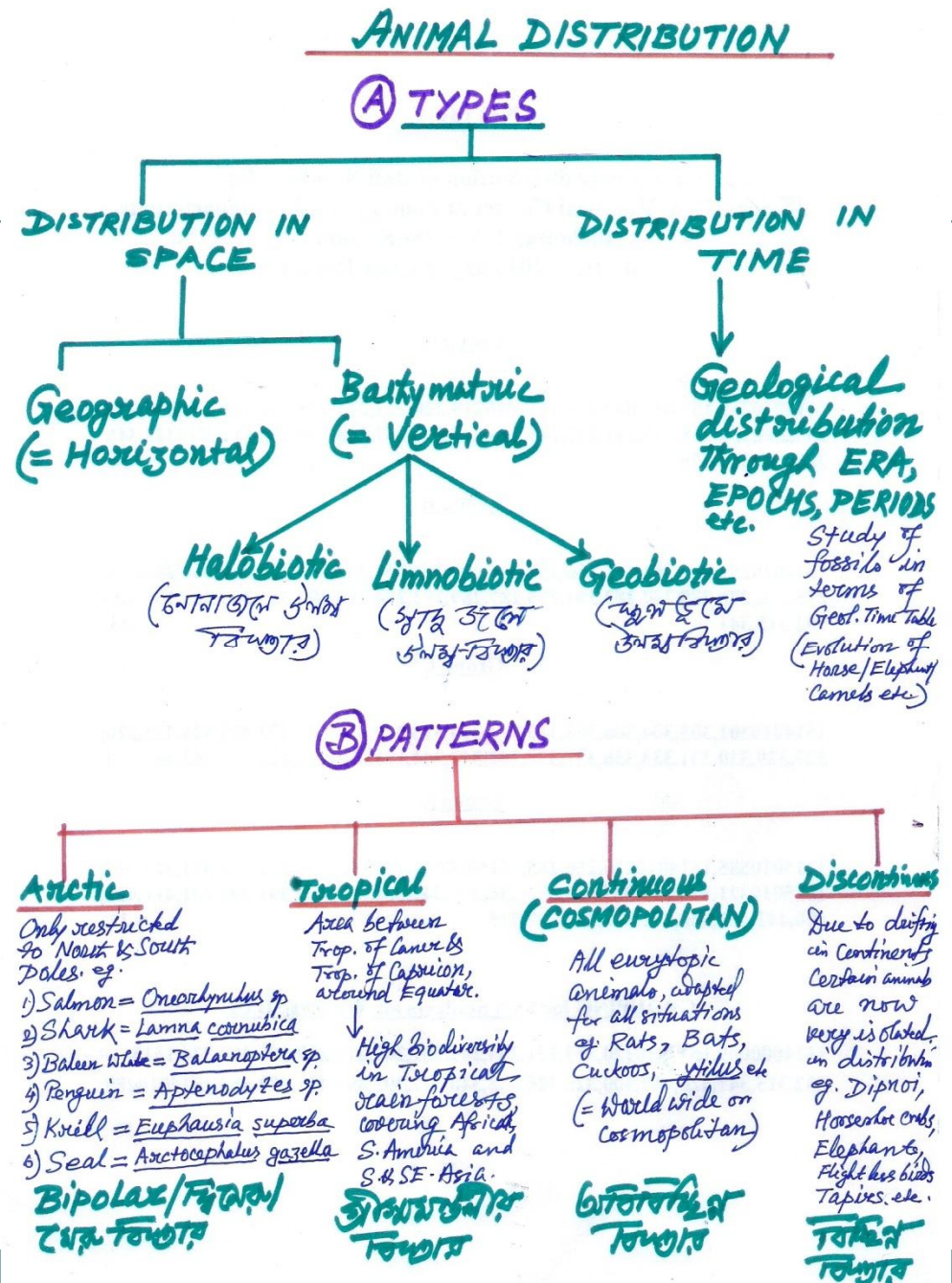
1. It was unable to reach the place where it is absent due to barriers.
2. It was unable to stay and adapt there because of unfavourable conditions.
3. It became modified into another species due to directional selection.

Other principles of distribution are as follows:

- Species are distributed in areas where they are most adapted.
- Different barriers act differently for different species depending on their modes of locomotion and dispersal.
- Poikilotherms generally spread slowly as compared to homeotherms (birds and mammals).
- Food, temperature, water etc. restrict animals to an area even without barriers. For example, penguins are restricted to Antarctica, giant panda to bamboo forests in China and Koala to eucalyptus forests of Australia.
- Parasites generally disperse with their hosts and predators along with prey.
- Majority of birds do not face any physical barriers due to their ability to fly over them.
- Low temperature prevents tropical animals to migrate northwards and polar and temperate animals to migrate southwards.
- For aquatic animals land is the barrier while for terrestrial animals sea, rivers and lakes are physical barriers.
- Oceans act as barriers for freshwater fishes and amphibians due to osmotic problems.

ANIMAL DISTRIBUTION

Animals are not uniformly distributed on land and in freshwater. They are restricted to certain places by several factors such as climate, food, shelter, geographic features, flora and fauna etc. Animal distribution actually occurs/ed in nature in two ways: in SPACE & in TIME. While, distribution can be classified into two general categories, such as: *Geographic* & *Bathymetric*; the 2nd one being again divided into *Halobiotic*, *Limnobiotic* & *Geobiotic*. On the other hand, the PATTERN of Animal Distribution includes 4 major categories: Arctic (Bipolar), Tropical, Continuous (Cosmopolitan) and Discontinuous.



Different Barriers

(A) Environmental

Terrestrial

Physiographic = Topographic

- a) High Mountain b) Large Water Body
- c) Extensive Desert d) Ext. Land
- e) Straits f) Ice mass.

Edaphic

- ⊗ Availability of specific Minerals, Salts, etc.
eg. Molluscs need $CaCO_3$ for its shell.

- Vegetative: a) Lack of Vegetation
- b) Extensive Forest

Climatic

- a) Temp, Moisture, Light, Cold wave etc.
- b) Rain Fall (Less or Heavy)
- c) Solar Radiation (Minimum - Maximum)
- d) Photoperiodism (Seasonal Intensity)

Aquatic

Fresh Water

a) Anadromous (Saline → Sweet)

- * Hilsa
- * Salmon

b) Catadromous (Sweet → Saline)

- * Eel

Marine Water

a) Land mass

b) Depth

c) Salinity

(B) Biological

Innate Factors

Anatomical

- * Puma from Cordillera hills of British Columbia to Patagonia.

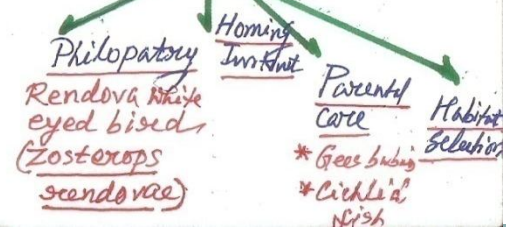
Physiological

- * Amphibians & Reptiles are restricted
- * Birds & Mammals wide in distr.
- * Parasites, Predators, Foods and struggle.

Behavioural

- * Placentals are more attacking and reproductively successful than Marsupials.

Psychological



Four main factors: Causing animals to prevent from spreading

- **1. Climate.** Animals are adapted to a combination of temperature and humidity that is affected by rainfall.
- **2. Vegetation.** Like animals, plants are also sensitive to temperature and rainfall and they affect dispersal of animals because the latter depend on vegetation for food.
- **3. Other animals.** Different animals at different trophic levels make food chains which are interwoven in a complex food web. Such interactions among animals often restrict a particular species to migrate alone to other areas.
- **4. Physical barriers.** Barriers such as mountains, deserts, rivers and oceans physically stop animals from invading new areas even when environment is conducive to their survival.

Factors Affecting the Distribution of :

Animal Species	Plant Species
a) Temperature	a) Temperature
b) Water	b) Water
c) Food Supply	c) Quantity of Light
d) Breeding & Nesting Sites	d) soil pH
e) Territory	e) Minerals (includes salts)

Discontinuous distribution. When continuity of distribution of a species is broken by uninhabited areas which are sometimes very large stretches of oceans. There are primarily four reasons why animals are distributed in widely separated areas.

1. Animals reach distant areas by sweepstake routes, as insects, snails and rats by rafting, turtles by floating and swimming and birds blown by storms.

2. The species was earlier distributed continuously but the land masses in the intermediate areas submerged, breaking the species into widely separated population.

3. Continental drift separated the continents and carried them to long distances, isolating the animals from other areas.

4. A widely distributed species can become extinct in the intermediate areas due to change in the climate to which the species is unable to adapt.

বিচ্ছিন্ন বিস্তারনের উদাহরণ : এখানে কিছু প্রাণীর উদাহরণ দেওয়া হল যাদের বিচ্ছিন্ন বিস্তারণ দেখা যায়।

▲ অমেরুদণ্ডী প্রাণী

উদাহরণ	বিস্তারণ
1. <i>Notodrilus</i> (এক ধরনের কঁচো)	নিউজিল্যান্ড, অস্ট্রেলিয়ার মধ্যভাগে ও উত্তর-পশ্চিমাংশে, দক্ষিণ আফ্রিকা, আমেরিকার দক্ষিণে ও মধ্যাংশে।
2. <i>Peripatus</i> (জীবন্ত জীবাশ্ম)	অস্ট্রেলিয়া, নিউজিল্যান্ড, ইন্দোনেশিয়ায় অঞ্চল, দক্ষিণ আমেরিকা ও আফ্রিকার উষ্ণমণ্ডল, ইস্ট ও ওয়েস্ট ইণ্ডিজ।
3. <i>Belostoma</i> (Giant waterbug)	আমেরিকা, আফ্রিকা, অস্ট্রেলিয়া, এশিয়ার দক্ষিণাঞ্চল।

▲ মেরুদণ্ডী প্রাণী

ফুসফুস যুক্ত মাছ	
1. <i>Lepidosiren</i>	দক্ষিণ আমেরিকার জলাভূমি
2. <i>Protopterus</i>	আফ্রিকা
3. <i>Neoceratodus</i>	অস্ট্রেলিয়া

▲ উভচর

4. <i>Necturus</i>	উত্তর আমেরিকা
5. <i>Proteus</i>	ইউরোপ

▲ সরীসৃপ

6. <i>Sphenodon</i> (জীবন্ত জীবাশ্ম)	নিউজিল্যান্ড
7. <i>Alligator</i>	চীন ও উত্তর আমেরিকা

▲ পক্ষী (দৌড়বাজ)

8. <i>Ostrich</i> (উটপাখী)— <i>Struthio</i>	আফ্রিকা
9. <i>Rhea</i>	দক্ষিণ আমেরিকা
10. <i>Cassowary</i> (<i>Casuaris</i>)	অস্ট্রেলিয়া, নিউ গিনি
11. <i>Emu</i> (<i>Dromiceius</i>)	অস্ট্রেলিয়া
12. <i>Kiwi</i> (<i>Apteryx</i>)	নিউজিল্যান্ড

▲ স্তন্যপায়ী

13. <i>Marsupials</i>	অস্ট্রেলিয়া, উত্তর ও দক্ষিণ আমেরিকা
14. <i>Camel</i> (উট)	এশিয়ার দক্ষিণ ও মধ্যভাগে, আফ্রিকা, দক্ষিণ আমেরিকা
15. <i>Elephant</i> (হাতি)	এশিয়া ও আফ্রিকা
16. <i>Armadillo</i> (<i>Dasybus</i>)	আফ্রিকা, উত্তর ও দক্ষিণ আমেরিকা
17. <i>Tapirs</i> (বিভিন্ন প্রজাতি)	<i>Tapirus</i> প্রজাতি মালয়, জাভা ও সুমাত্রা দ্বীপপুঞ্জ; <i>Tapirella</i> প্রজাতি মধ্য ও দক্ষিণ আমেরিকা

□ ব্যারিয়ার (Barriers) : প্রাণি-বিস্তারে বা বিসরণে বাধা :

প্রাণী-বিস্তারনের পক্ষে বাধাগুলিকেই ব্যারিয়ার বলা হয়। বাধাগুলিকে বর্তমানে দুটি প্রধান শ্রেণীতে ভাগ করা যায়—(I) বহিঃস্থ (Extrinsic), (II) অন্তর্নিহিত (Intrinsic)।

Examples of Discontinuous Distribution :

- *Peripatus* (Phylum Onychophora) has 75 species distributed in Southeast Asia, East Indies, Australia, New Zealand, Africa, South and Central America.

- The three surviving genera of lungfishes occur in three different continents;

Protopterus in Africa, *Lepidosiren* in South America and *Neoceratodus* in Australia.

- Similarly the limbless amphibians (Apoda or Gymnophiona) of the genera *Ichthyophis*, *Gegenophis* and *Dermophis* occur in Africa, South America, Central America, South Asia and East Indies.

- Ostriches are distributed in the southern hemisphere; *Rhea americana* in Argentina and Brazil, *Struthio camelus* in Africa, Emu in Australia, Cassowaries in North Queensland and New Guinea and Kiwi in forests of New Zealand.

- Marsupials occur in Australia but one family Didelphidae occurs in South America that includes opossum (*Didelphis*), water opossum (*Chironectes*) and opossum rat (*Coenolestes*).

- The common camel (*Camelus dromedarius*) occurs in the Middle East, India and Northern Africa; *Camelus bactrianus* is found in Mongolia and China, while two species, *Llama vicuna* and *Llama guanaco* are found in the mountainous regions of South America.

- Of the two elephant species surviving today, *Loxodonta africana* occurs in Africa while another species, *Elephas maximus* is found in India, Burma, Thailand and Sri Lanka.

- Alligators occur in America and China; *Alligator*

mississippiensis in Americas, *Caiman* in South America and *Alligator sinensis* in China.

MEANS OF DISPERSAL



All animals do not spread across the sea or other barriers with the same speed, some spread faster and others slowly and some do not cross the barriers at all. Therefore, distribution also depends on the animal's body size, psychology, reproductive rate, locomotory organs, physiological endurance and some means to carry them to long distances across barriers. Some means of dispersal are discussed below.

1. **Land bridges.** They are land connections between two large land masses which are separated by sea that may have existed in the past and facilitated movement of animals across them.
2. **Sweepstakes.** Rafts, driftwood, icebergs and other floating objects in the sea can carry small animals, their eggs and other stages to long distances.
3. **Winds and storms.** Wind is used by many plants for dispersal of their seeds for which they possess specialised aerodynamic structures to keep them airborne and drift to long distances.
4. **Through birds.** Birds being gifted with the power to fly can cross long stretches of sea to travel from one continent to another and to remote islands in the sea. Water birds can carry eggs of snails and seeds of plants on their legs and transport them across the sea.
5. **Human agency.** Rats, cockroaches, houseflies and grain feeding insects have been constant companions of man in habitation as well as in travel. They are quite common in cargo ships and have spread to all places visited by man.

Land Bridges: Types



Land bridges are of two types, namely, **Corridor bridges** and **Filter bridges**.

1. Corridor bridges. They are land connections of continent size stretching across oceans and connecting two continents. It is again of the following types:

South Atlantic Corridor. This bridge is supposed to have connected South America with Africa and also included islands of St. Helena.

Lemuria Corridor. The continent of Lemuria is believed to have existed till early Coenozoic and connected Africa, Madagascar and India across which lemurs and their relative lorises spread.

Antarctica Corridor. This would have been the largest land bridge that connected South America with Australia through Antarctica during

Panama Corridor. During end Cretaceous and early Palaeocene North America and South America were connected by a narrow corridor, through which migrated to the south marsupials and early placentals such as Condylartha which were ancestors of modern ungulates.

Arctic Corridor. During Mesozoic Nearctic and Palaearctic Regions were connected by a broad corridor that later narrowed but continued until late Eocene, allowing free exchange of marsupials and insectivores and also freshwater fishes and amphibian.

2. Filter bridges. Filter bridges are series of islands between two land masses that allow some animals to spread across but stop others. The animals could spread by “island hopping”, crossing small stretches of sea by swimming, flying, rafting or through wind.

Theories of Animal Distribution



Several theories have been put forward to explain how and why animals spread from their place of origin to where they are now found, sometimes travelling thousands of kilometres and crossing barriers in the process. Few of the following theories explain the distribution of plants and animals across continents:

1. **Brown's theory of centrifugal speciation.** It has been observed that largest populations of a species exist in the most favourable areas. Due to increasing numbers in these areas a population pressure may build up forcing some pioneers to venture into the peripheral areas which may not be as habitable.
2. **Age and area theory of Willis.** J. C. Willis (1949) gave this theory based on his studies on plant geography. Plants have a tendency to enlarge their range of distribution slowly in all directions and hence the age of a species must be proportional to the area occupied by it at present.
3. **Climate and evolution theory of Matthew.** W.D. Matthew (1939) being a geologist and mammalian palaeontologist believed in the permanency of continents and ocean basins. He thought that continental drift, corridors and filter bridges played no role in the distribution of animals.
4. **Continental drift theory of Alfred Wegener.** The theory that the present day position of continents is not permanent but the continents constantly drift and change positions.



SEE YOU NEXT TIME

THANKS for your Patience

**Dr. R. Debnath
Assoc. Prof.
Zoology Deptt
Nov, 2018**