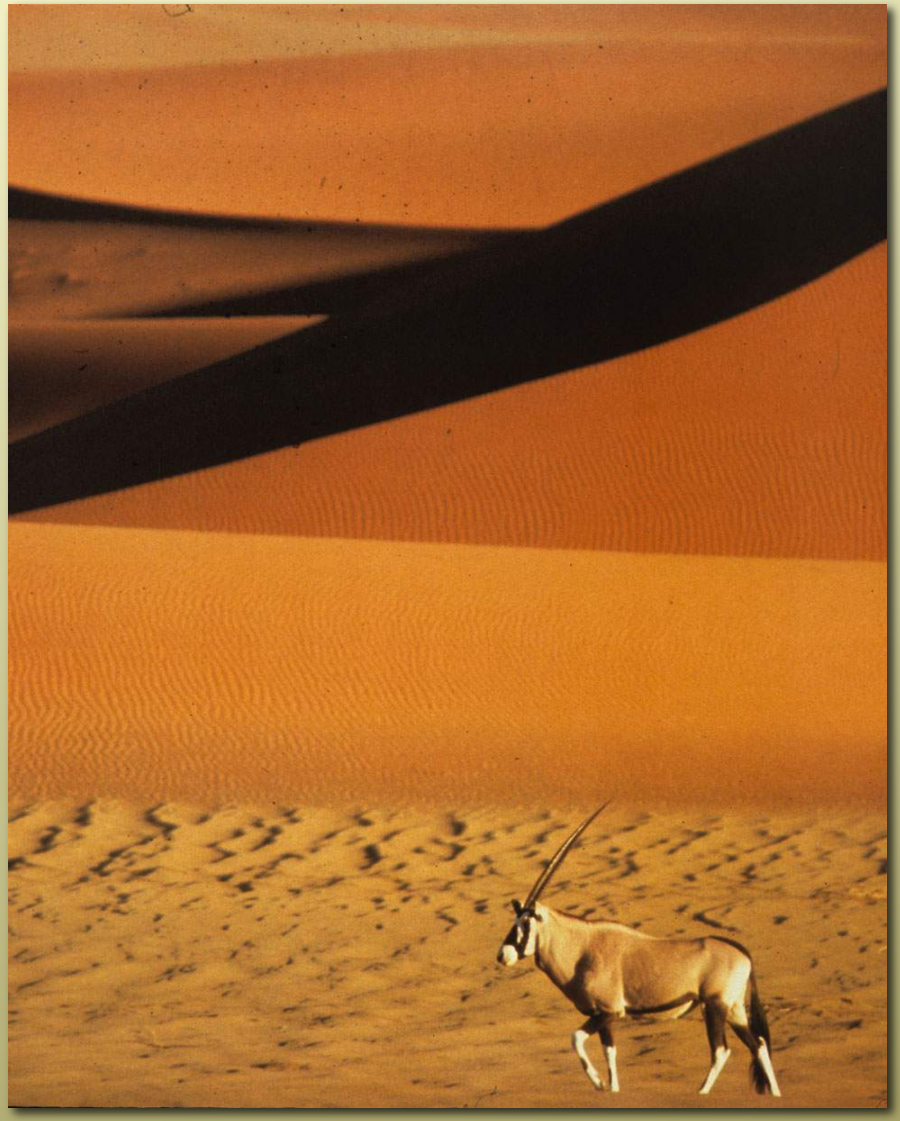

Deserts

Deserts

- what are deserts?
- relative term - transitions occur latitudinally with more xeric thorn forests and with grass savannas

Mojave Desert



Namib Desert

Deserts

- what are deserts?
- relative term - high elevation tropical mountains (paramo, etc.) are essentially “desert” like

Haleakala Crater - Maui

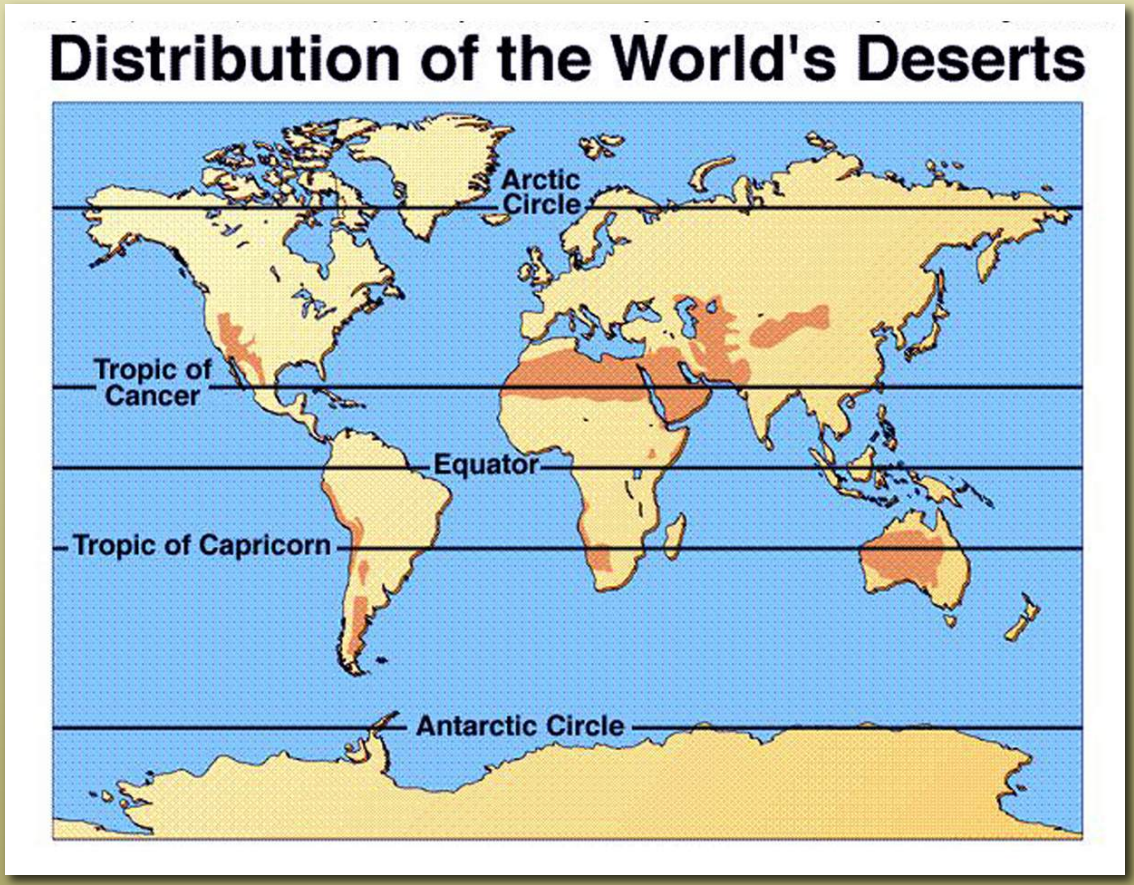
Deserts

- what are deserts?
- relative term - high elevation tropical mountains (paramo, etc.) are essentially “desert” like

Opuntia (Cactaceae) in high Andean puna (Peru)

Deserts

- what are deserts?
- subtropical arid regions where potential evaporation (>2000mm) is >> annual precipitation (<200mm)

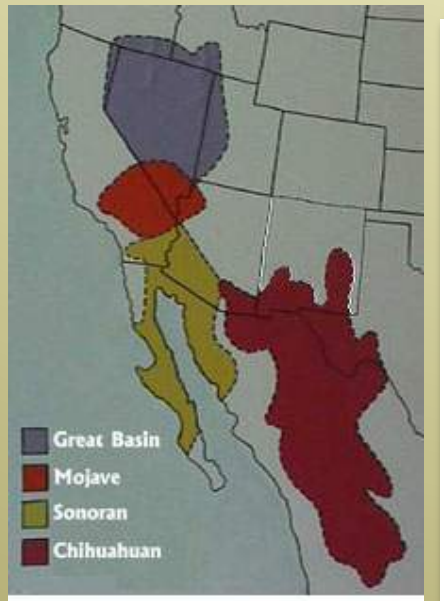


Deserts

- distinction between subtropical and temperate (cool or cold winter) deserts

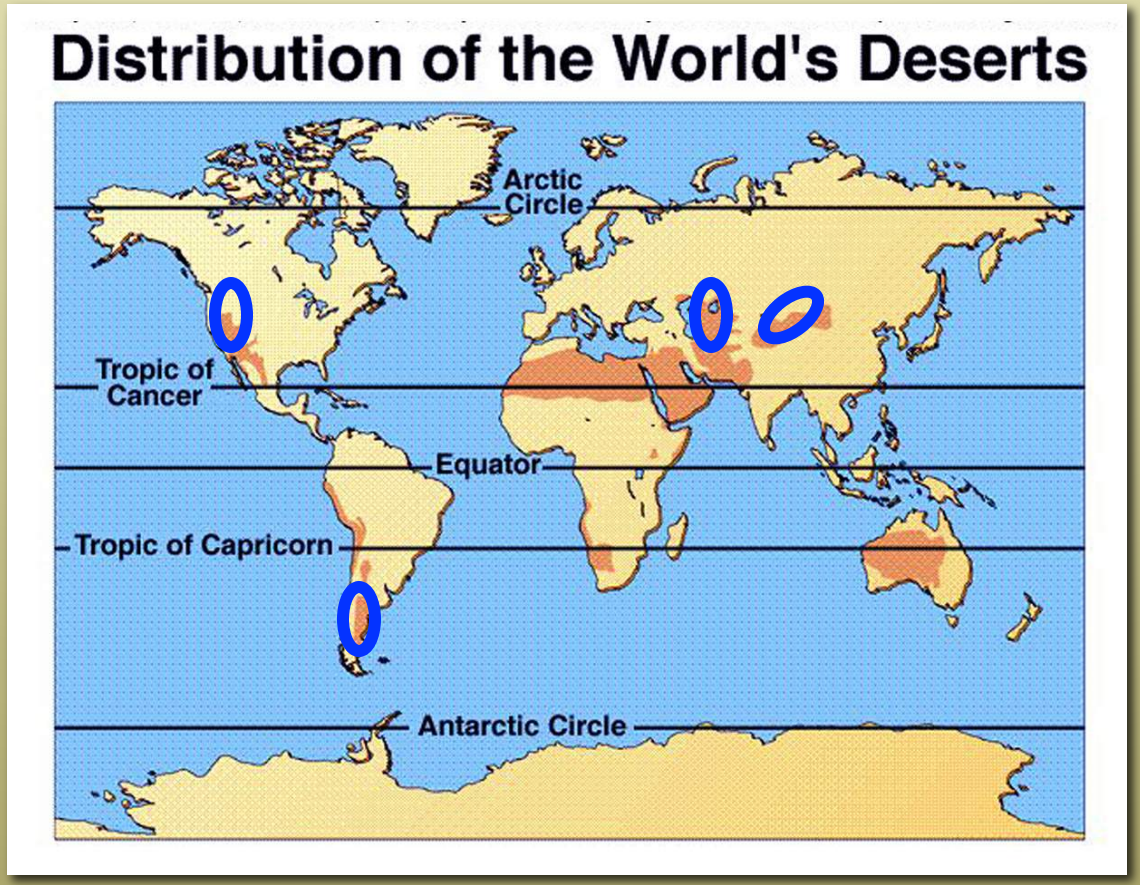
Great Basin

Gobi Desert



Deserts of North America

Patagonian Desert

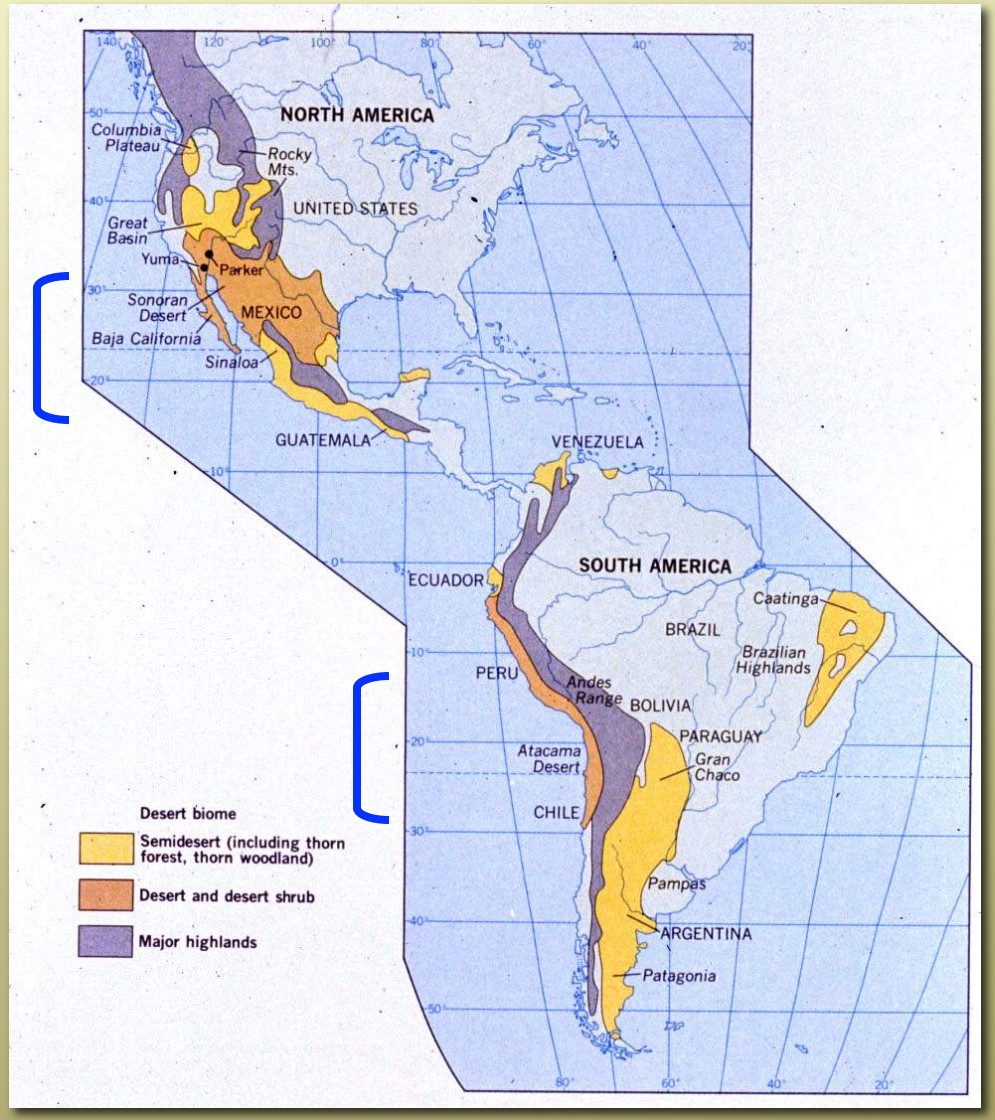


Desert Locations

- lie between 15° and 30° centered on Tropics of Cancer and Capricorn on west sides of continents

Sonoran,
Mojave,
Chihuahuan

Atacama

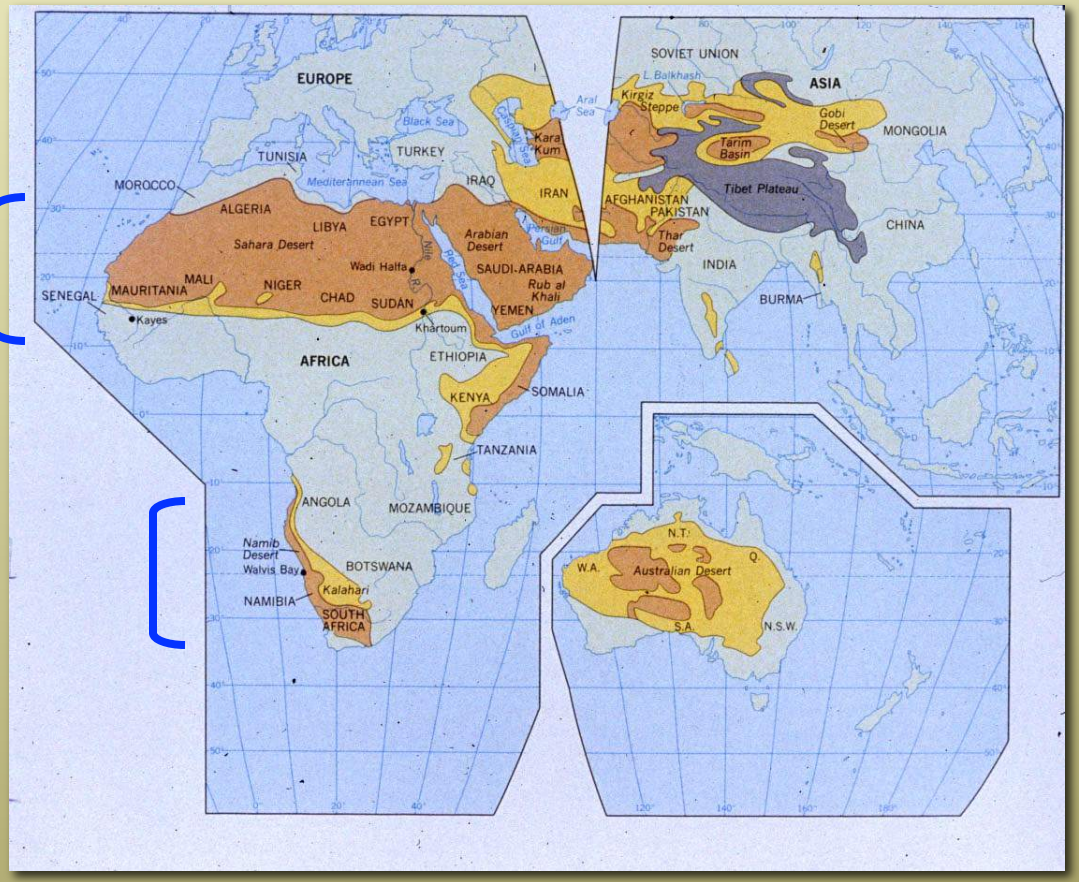


Desert Locations

- lie between 15º and 30º centered on Tropics of Cancer and Capricorn on west sides of continents

Saharan

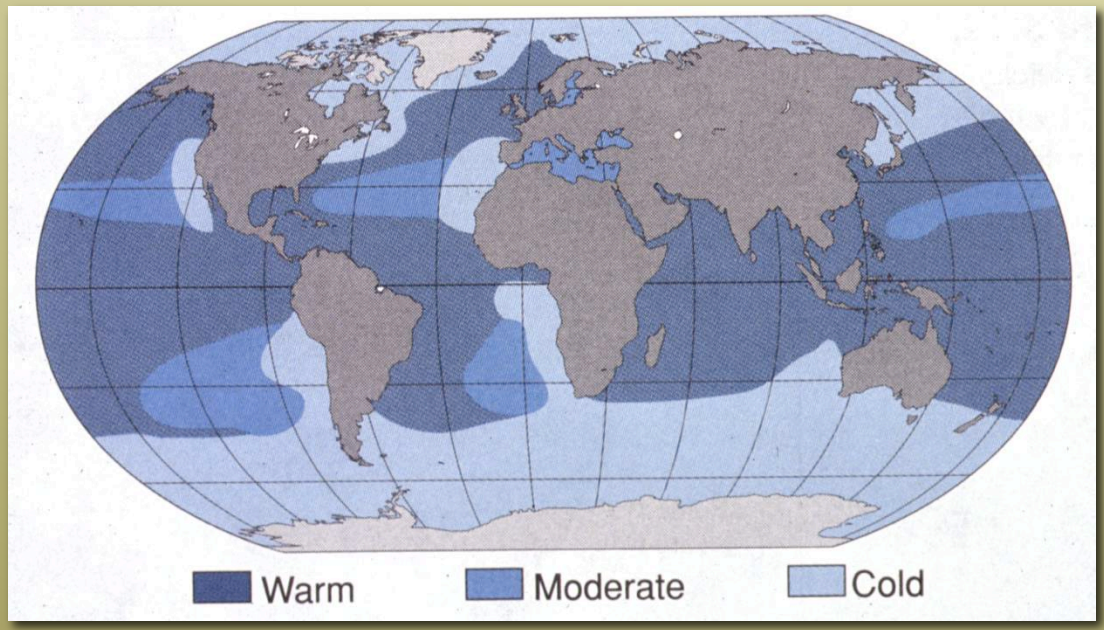
Namib, Australian

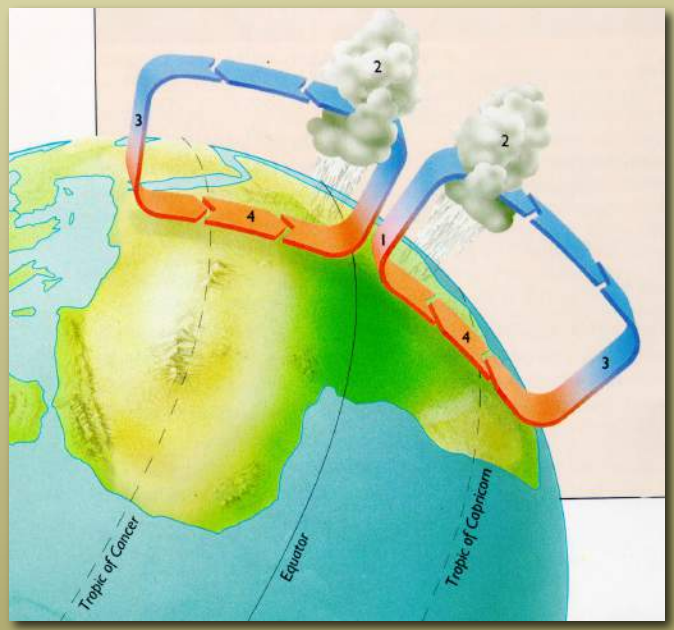


Desert Climate

- desert climate due to subtropical highs and adiabatic warming of dry air . . .

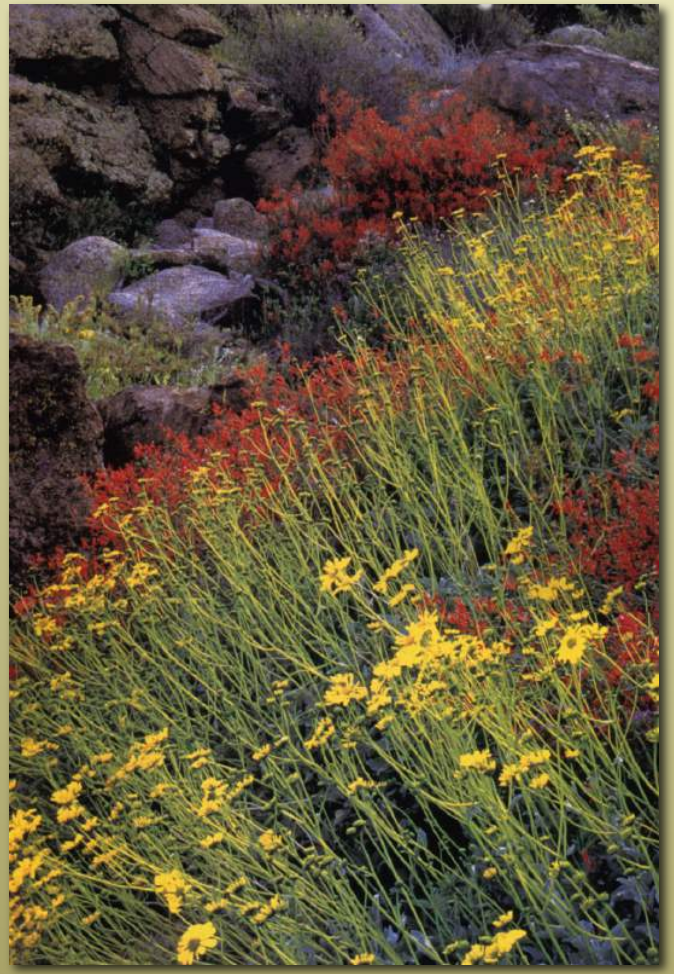
- . . . and circulation of cold currents (holding little moisture above the currents) along west sides of continents



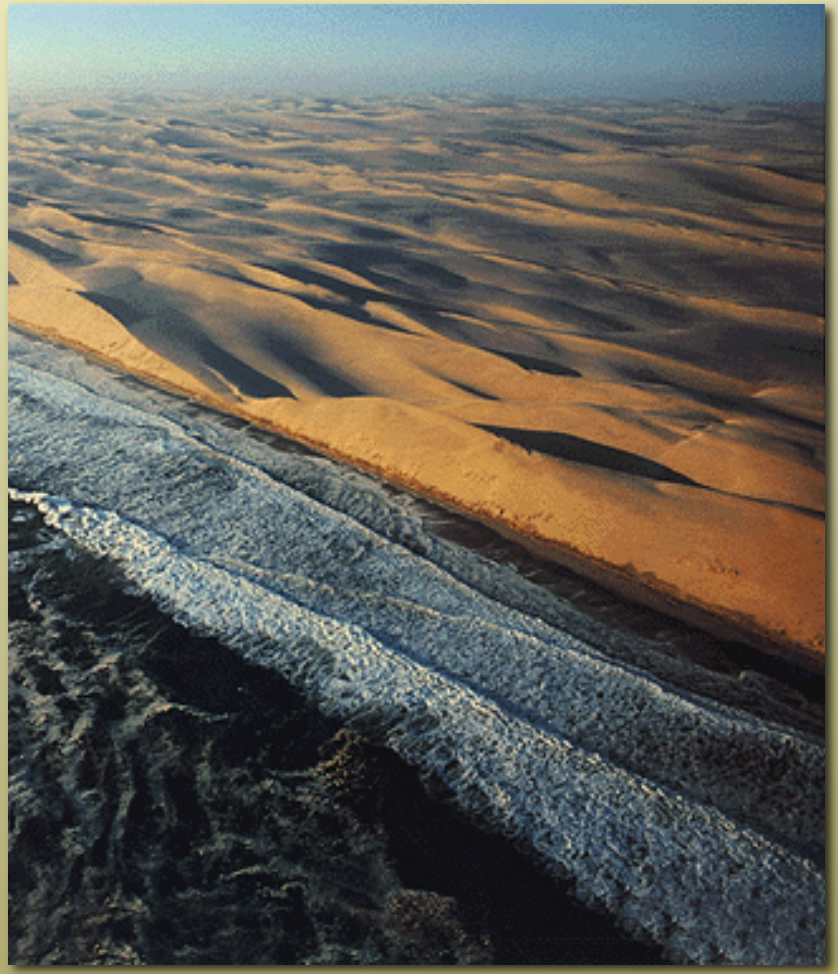


Desert Climate

- variation in amount of precipitation from semiarid to rainless deserts



Mojave



Namib (Skeleton coast)

Desert Climate

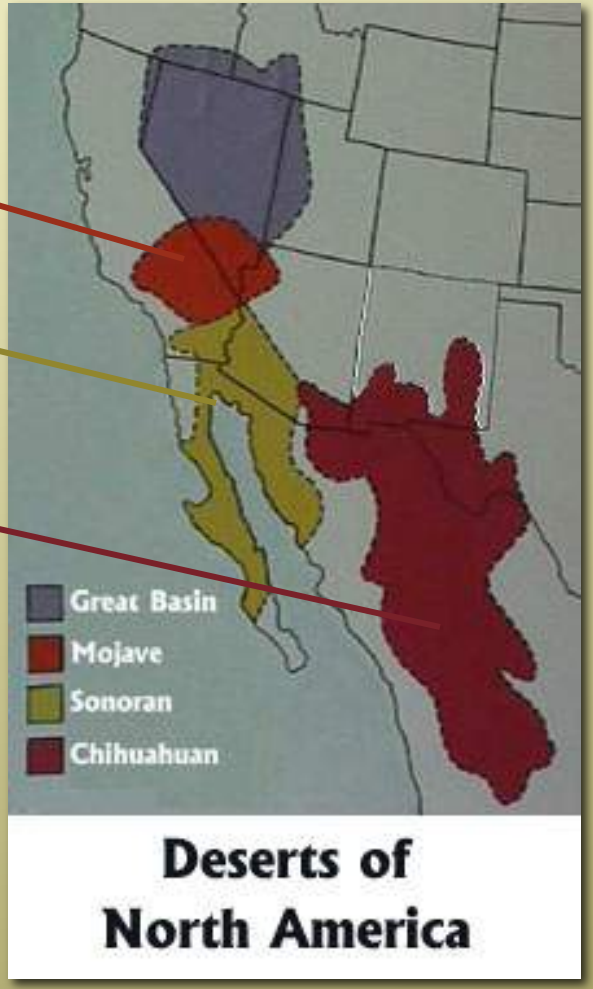
- variation in seasonality of precipitation

Mojave - winter rains (Mediterranean!)

Sonoran - light winter rains and heavier summer rain (bimodal)

Chihuahuan - only summer rain (subtropical!)

Namib, Atacama - only fog, no rain



Desert Climate

- soil types: counter-intuitive, but clay soils form driest habitats, sandy soils better water retention, and rocky/ fissured soils provide the wettest habitats

Desert Life Forms

- Halophytes ("salt plants") - adaptations to salt left behind as water is evaporated at surface of soil

Salicornea (Chenopodiaceae)

Salt accumulators (often succulent)

Salt excretors

Tamarix (Tamaricaceae)

Desert Life Forms

- Malakophyllus (“soft leaved”) xerophytes (“arid plants”) - adaptations to water stress by wilting under dry conditions

Asteraceae - daisy family

Sphaeralcea (Malvaceae) - desert globe mallow

Desert Life Forms

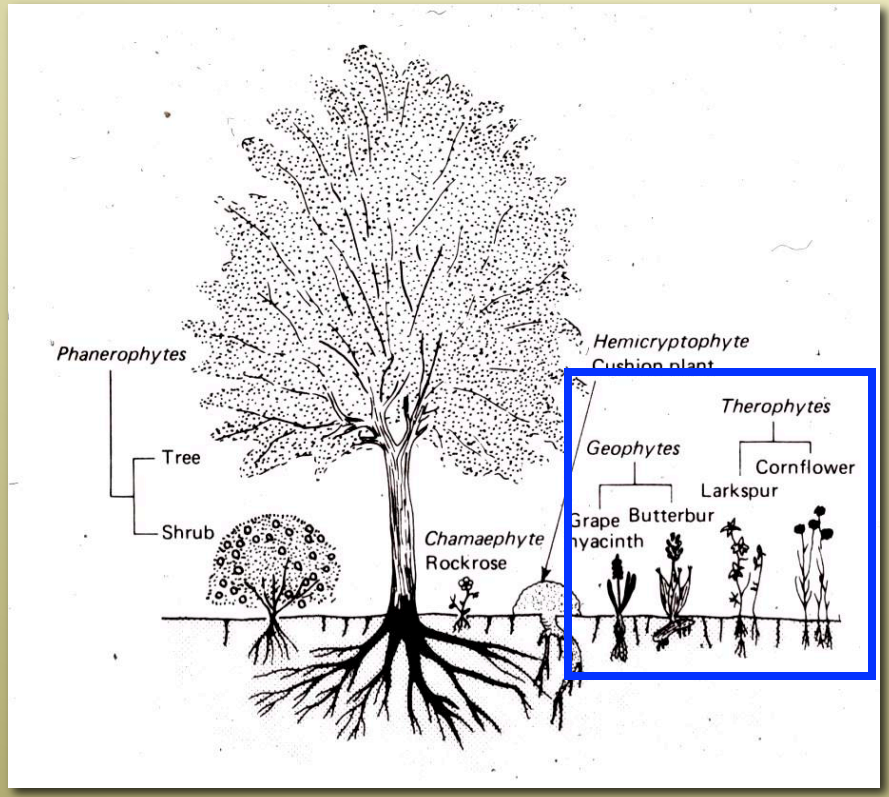
- Succulents - adaptations to water stress by storing water in swollen tissue

leaves *Aloe* - Africa

stems *Opuntia* - North America

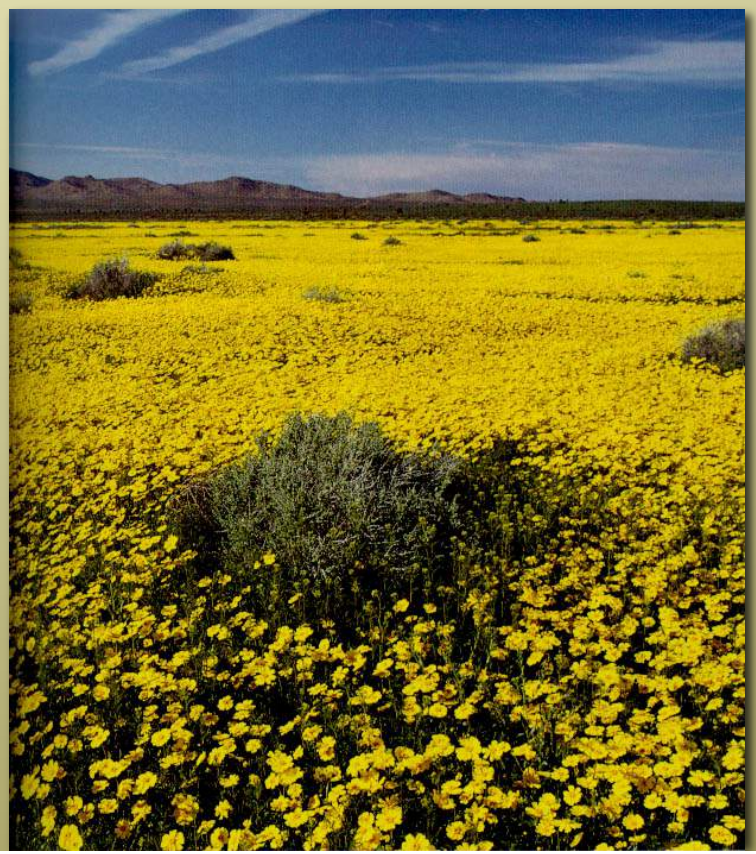
Desert Life Forms

- Ephemerals - adaptations to water stress by short life



Geophytes (survive under ground)

Therophytes (annuals, survive by seeds)



Desert Life Forms

- Ephemerals - adaptations to water stress by short life

	Phanero. (trees/ shrubs)	Chamae. (near ground)	Hemicrypto (leaf litter)	Crypto. (under ground)	Thero. (annuals)
Rainforest	96%	2%	0%	2%	0%
Desert	11%	7%	27%	14%	**41%**
Temperate Deciduous Forest	15%	2%	49%	22%	12%
Tundra	0%	23%	61%	15%	1%

Desert Life Forms

- Plant defenses - physical and chemical

Table 4.13 The physical and chemical defences of desert plants against herbivores (after Orians *et al.*, 1977)

		Chemical defences	
Life form	**Physical defences**	**Short-lived tissues**	**Long-lived tissues**
ephemerals	leaves easily chewed; no spines	toxins	–
root perennials	leaves easily chewed; no spines	toxins	digestion-reducing substances
deciduous perennials	leaves easily chewed; may have spines	toxins; digestion-reducing substances	toxins; digestion-reducing substances; low nutrient content
evergreen perennials	leaves tough; usually not spinescent	toxins; digestion-reducing substances	toxins; digestion-reducing substances; low nutrient content
succulents	photosynthetic tissue very tough; many spines	–	toxins; digestion-reducing substances; low nutrient content

Cactaceae - New World spine protected

Euphorbia - Old World spine & toxin protected

Desert Life Forms

- Plant defenses - physical and chemical

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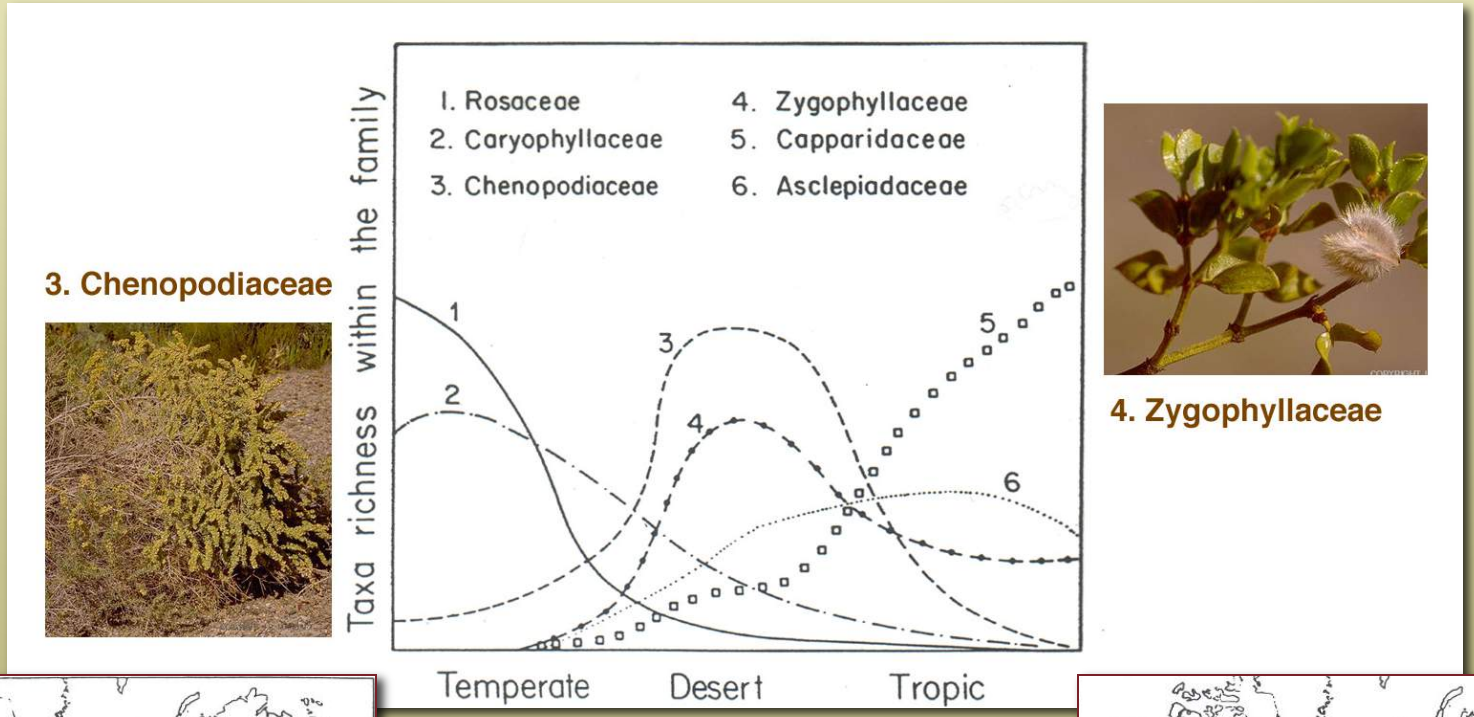
Larrea tridentata
– Creosote bush

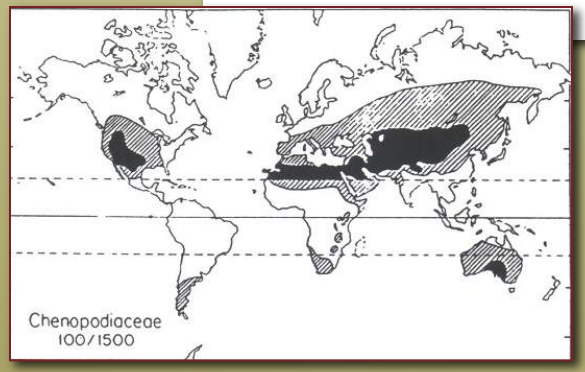
Desert Florisitics

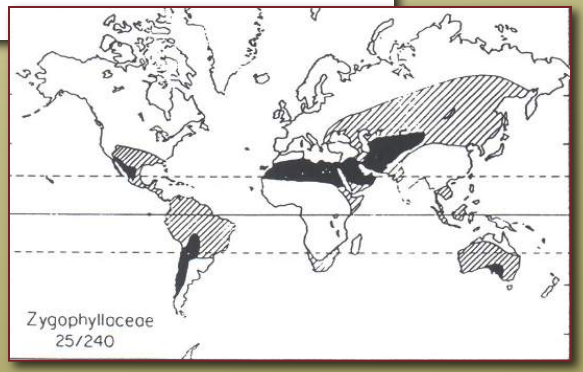
- Three families species richer in deserts than elsewhere



3. Chenopodiaceae

4. Zygophyllaceae





Desert Florisitics

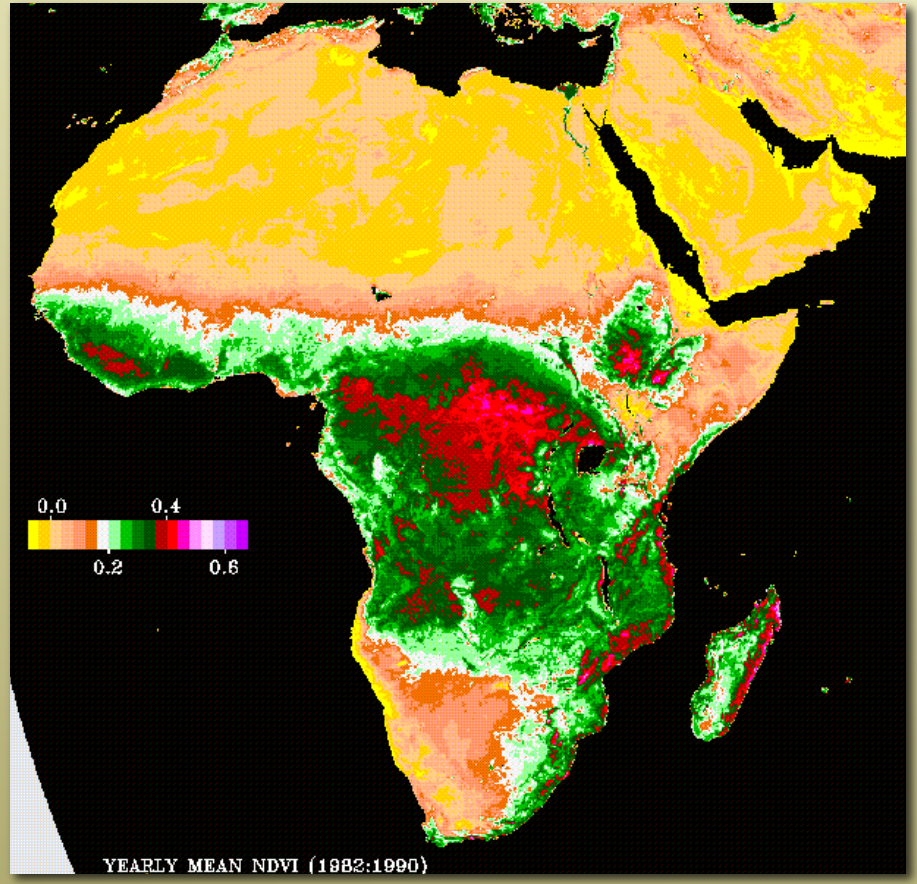
- Three families species richer in deserts than elsewhere

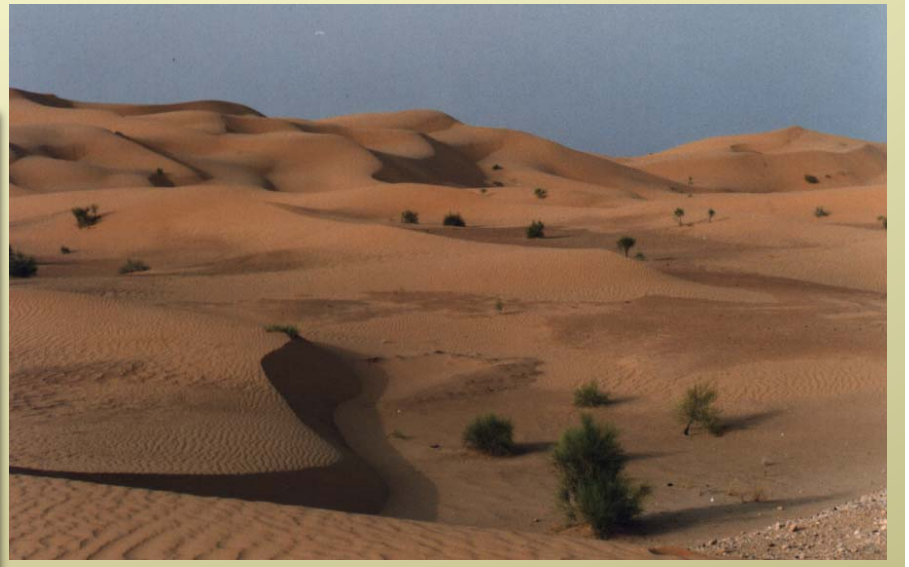
Frankeniaceae

Frankenia chilensis

African Deserts

- Sahara





Yellow indicates lowest photo-synthetically absorbed radiation

African Deserts

- Sahara

Woody plants: *Phoenix* (date palm) and shrubs (*Acacia*, *Tamarix*, *Ephedra*)

Annuals: Brassicaceae; but also perennial herbs like grasses

Tamarix - tamarisk

"mustard" (Brassicaceae)

Phoenix dactylifera (date palm) - Tunisia

African Deserts

- Sahara

Stem succulents:
Apocynaceae (milkweeds)

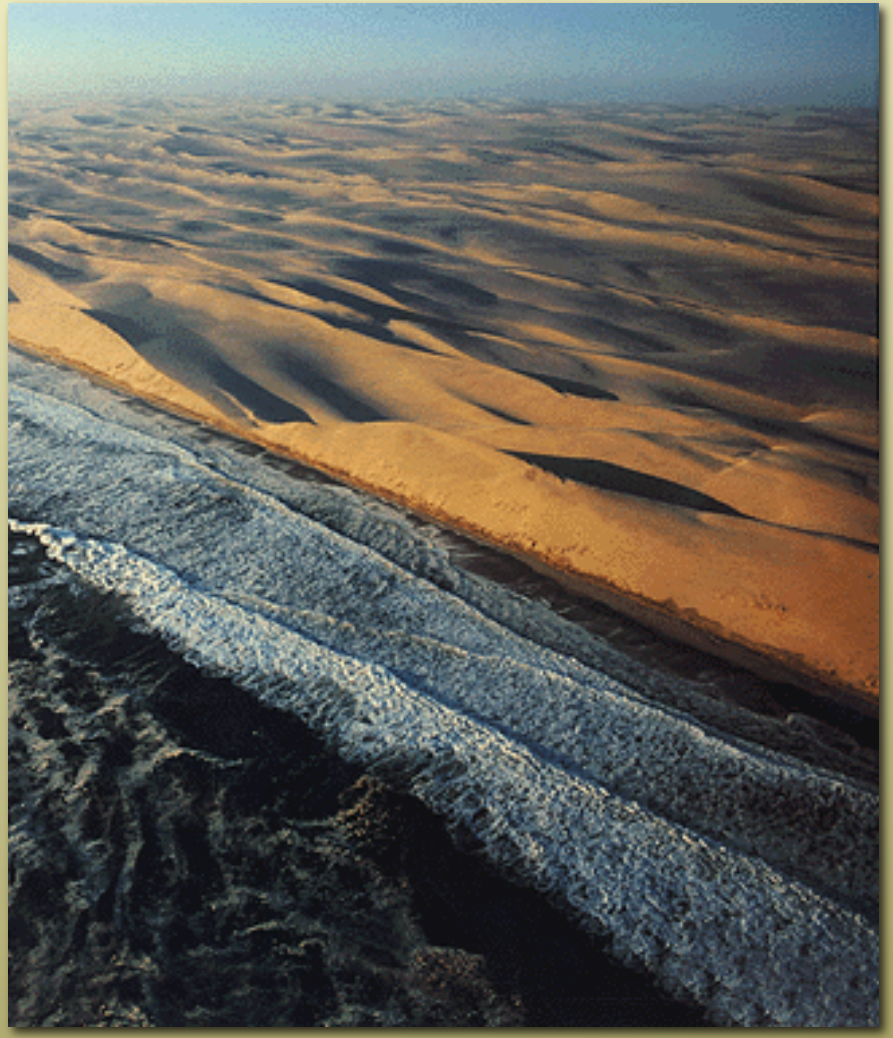
Caralluma & Sarcostemma
(Apocynaceae)
Ethiopia

Loranthaceae parasitic on *Acacia*
Ethiopia

Parasites: Loranthaceae

African Deserts

- Namib - western southern Africa

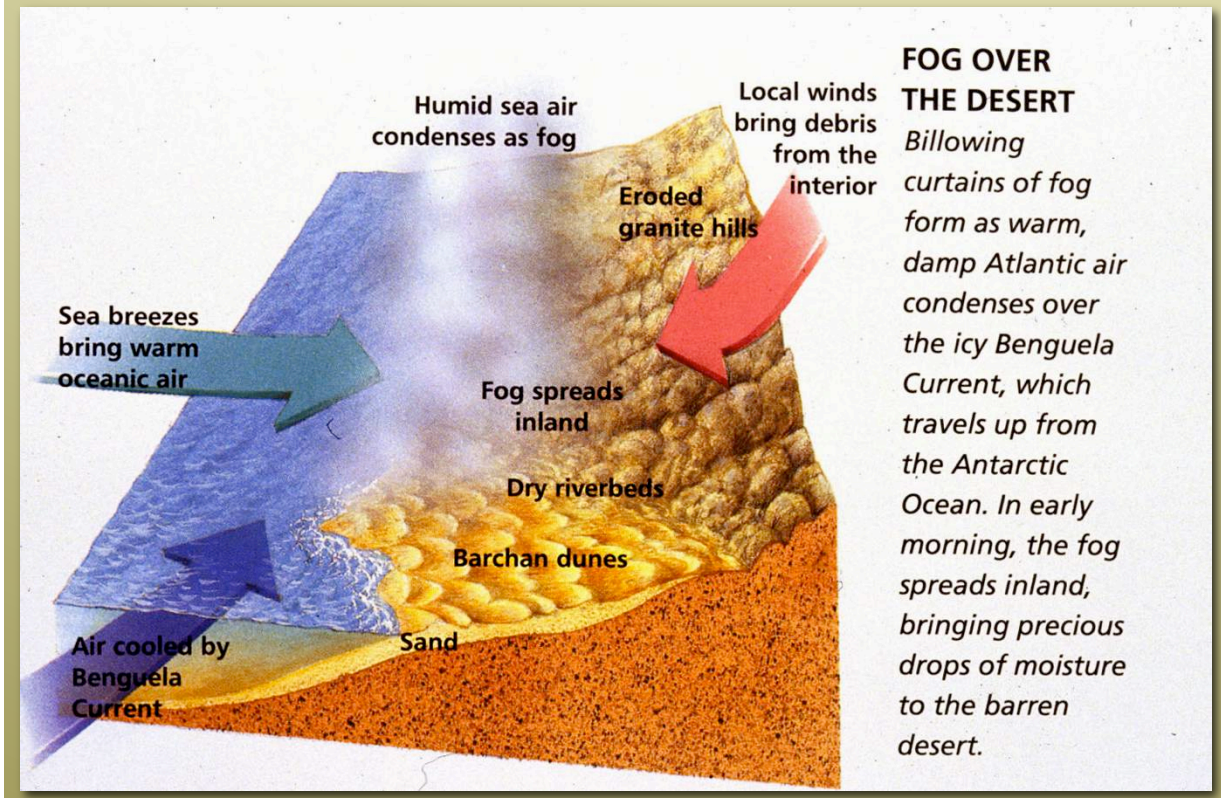


African Deserts

- Namib - western southern Africa

Fog desert: fog only moisture for most of the year along coast

Darkling beetle - dew specialist



FOG OVER THE DESERT
Billowing curtains of fog form as warm, damp Atlantic air condenses over the icy Benguela Current, which travels up from the Antarctic Ocean. In early morning, the fog spreads inland, bringing precious drops of moisture to the barren desert.

African Deserts

- Namib - western southern Africa

Fog desert: fog only moisture for most of the year along coast

Darkling beetle - dew specialist

Welwitschia mirabilis

- nephelophyte
- fog specialists

African Deserts

- Namib - western southern Africa

Eriospermum paradoxum

Trachyandra

- nephelophyte - fog specialists of Namaqualand -the “curlie-whirlies”

African Deserts

- nephelophyte - fog specialists of Namaqualand -the “curlie-whirlies”

Trachyandra

African Deserts

Desert geophytes under dew and fog: The “curly-whirlies” of Namaqualand (South Africa)

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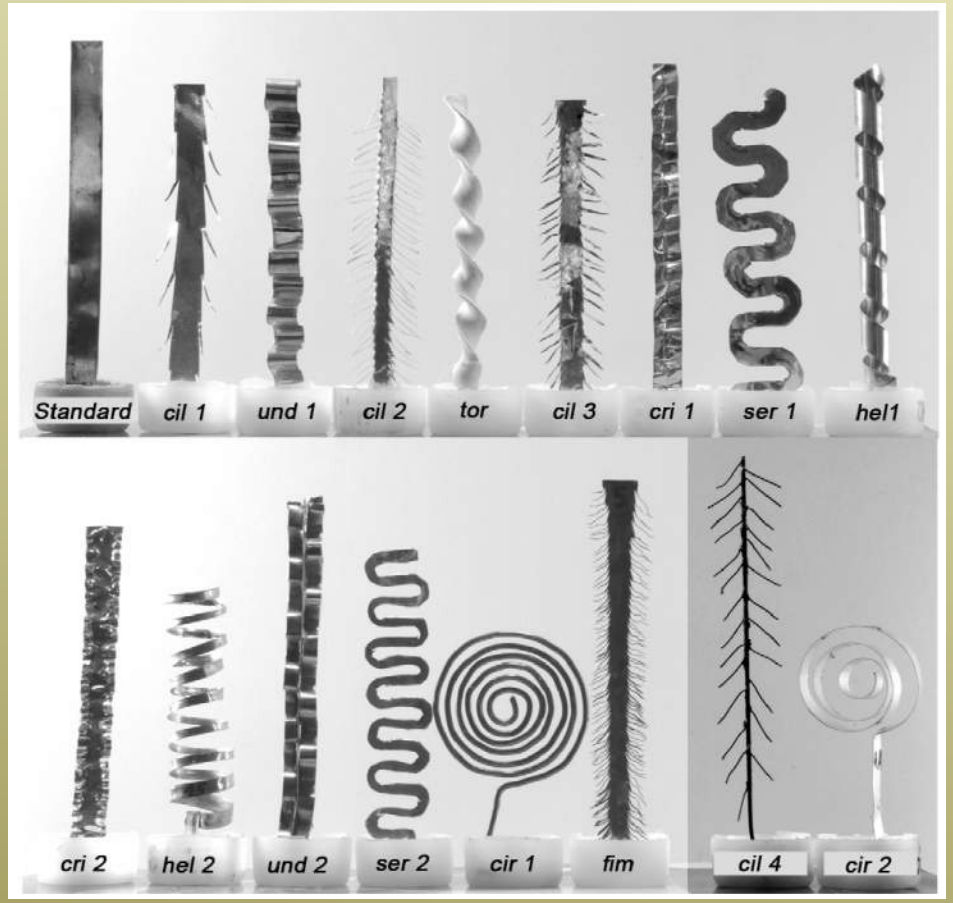
[a] Biozentrum für Botanik der Universität Wien, Rennweg 14, A-1030 Wien, Österreich, Austria
[b] Institut für Biologie/ Systematische Botanik und Pflanzengeographie der Freien Universität Berlin, Altensteinstr. 6, D-14195 Berlin, Deutschland, Germany



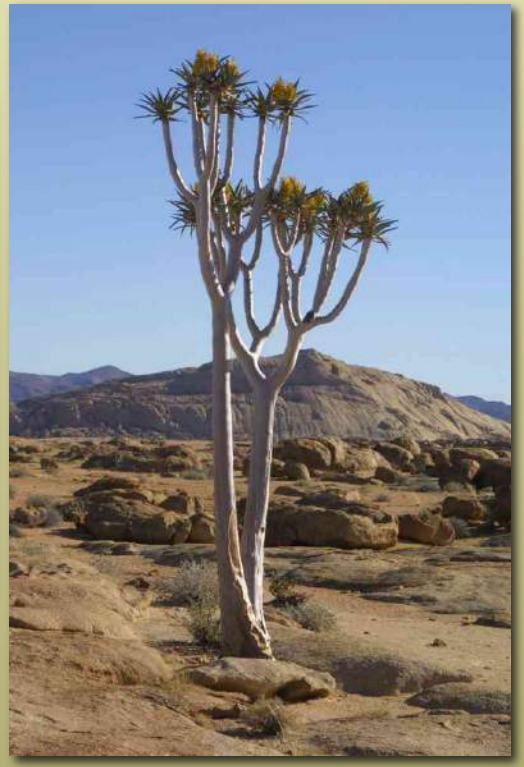
Trachyandra

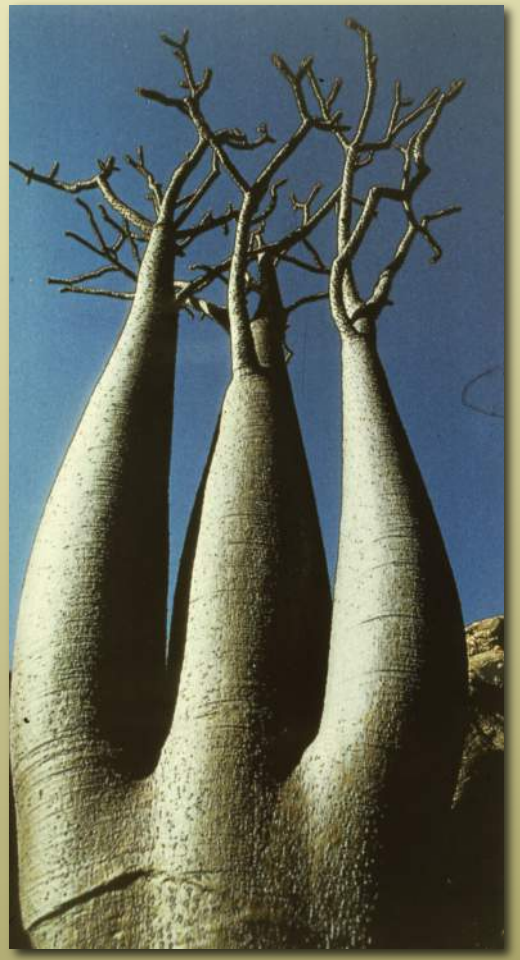
African Deserts

- Namib - western southern Africa

Stem succulents*: Aloe* (Liliaceae s.l.), *Euphorbia*, *Pachypodium* (Apocynaceae)

Aloe - quiver plant





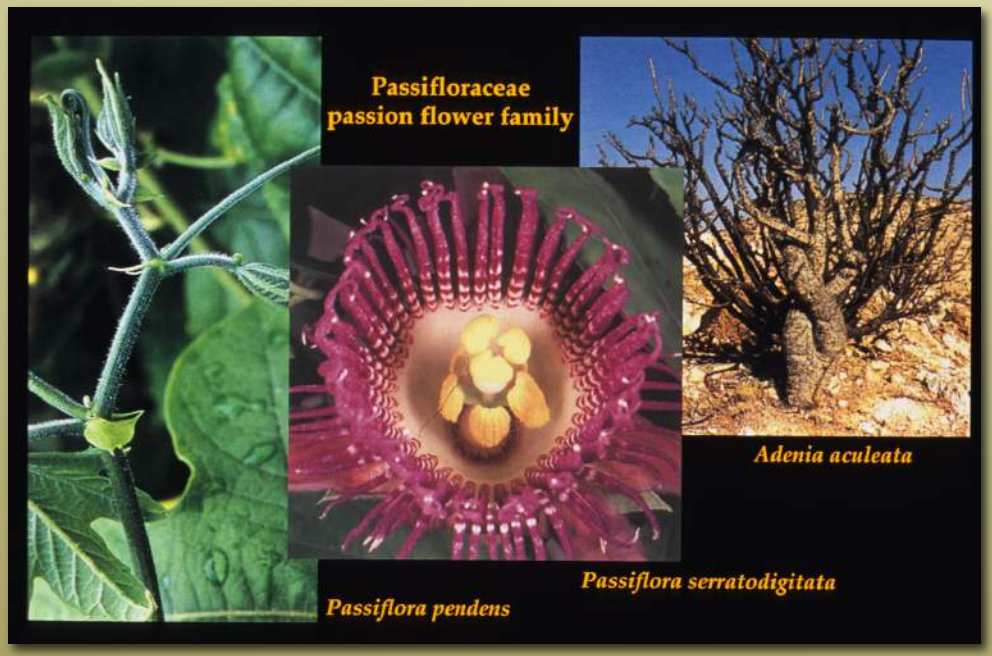
Pachypodium

African Deserts

- Namib - western southern Africa

Stem succulents*: Stapelia* (Apocynaceae) - cactus mimic; *Adenia* (Passifloraceae)

Stapelia - carrion flower



Adenia

African Deserts

- Namib - western southern Africa

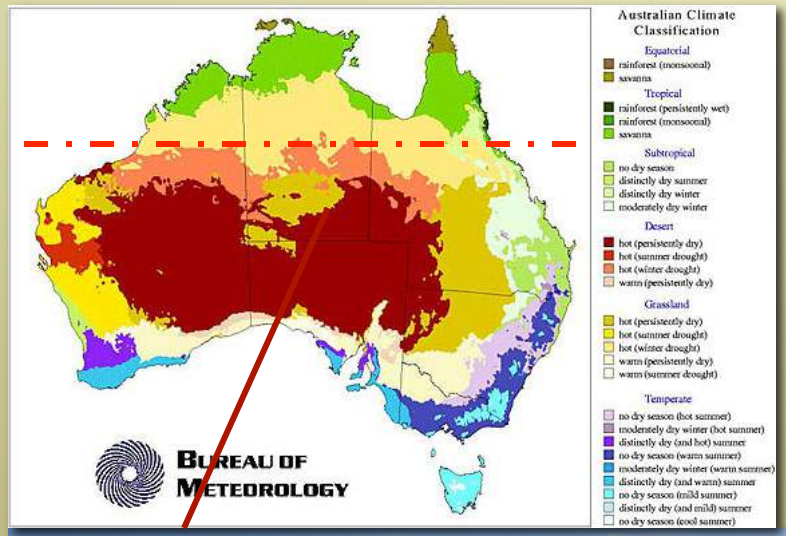
Leaf succulents:
Aizoaceae - cactus mimics

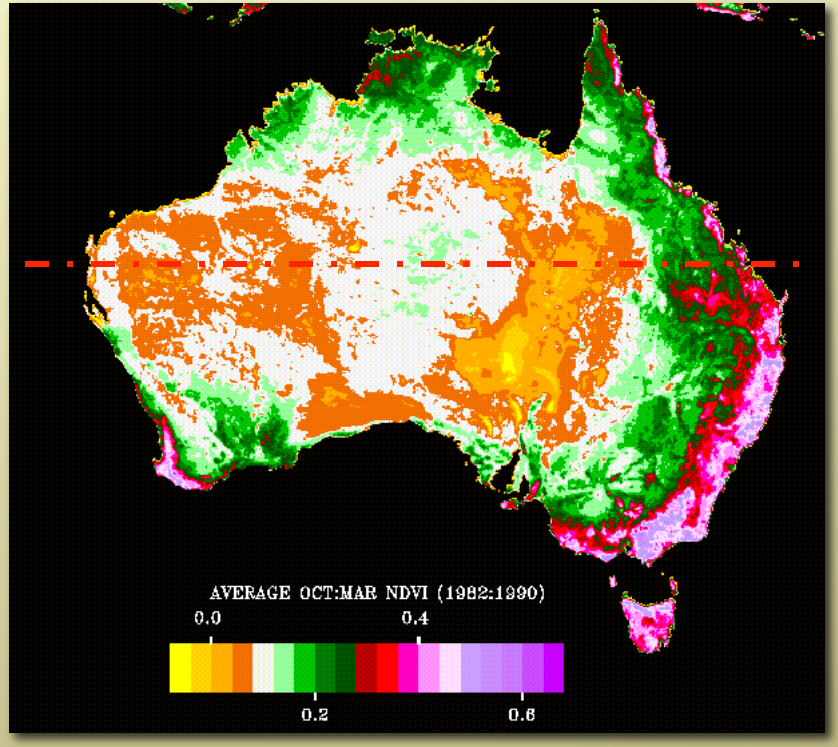
Delospermum

Lithops - living stones

Australian Deserts

- One quarter of Australia is “desert”- largest is the Simpson desert

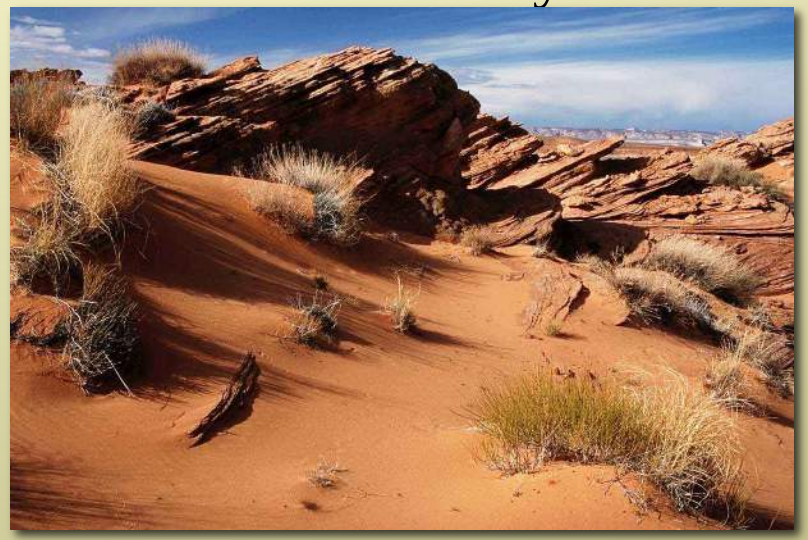




Deserts straddle Tropic of Capricorn

Australian Deserts

- Spinifex desert type: desert grassland dominated by *Triodia* grass hummocks



Australian Deserts

- Spinifex desert type: desert grassland dominated by *Triodia* grass hummocks

Casuarina - desert oak - N2 fixing!

Grass trees, Xanthorrhoeaceae (endemic to Australia, 9 genera, 75 spp.)

Australian Deserts

- Saline desert type: low vegetation dominated by salt-tolerant bluebush, saltbush, and other Chenopodiaceae

Maireana (Amaranthaceae) - bluebush

Williams Creek - saline

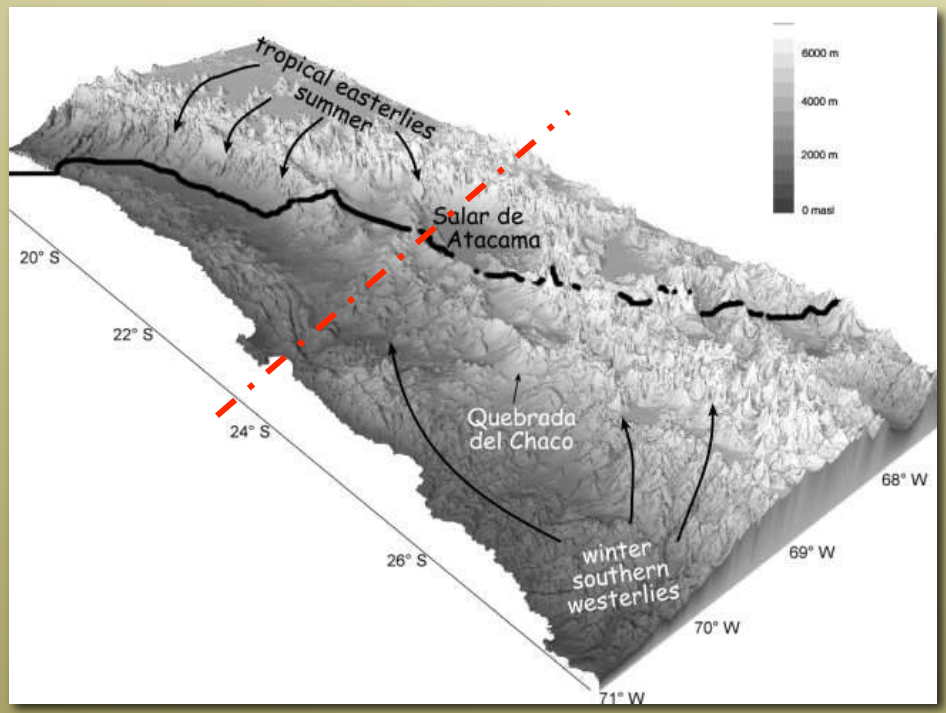
Australian Deserts

- Mulga desert type: perhaps transitional with extreme arid woodlands but covers 20% of Australia - dominated by *Acacia anerua* (mulga)

Acacia aneura - mulga

South American Deserts

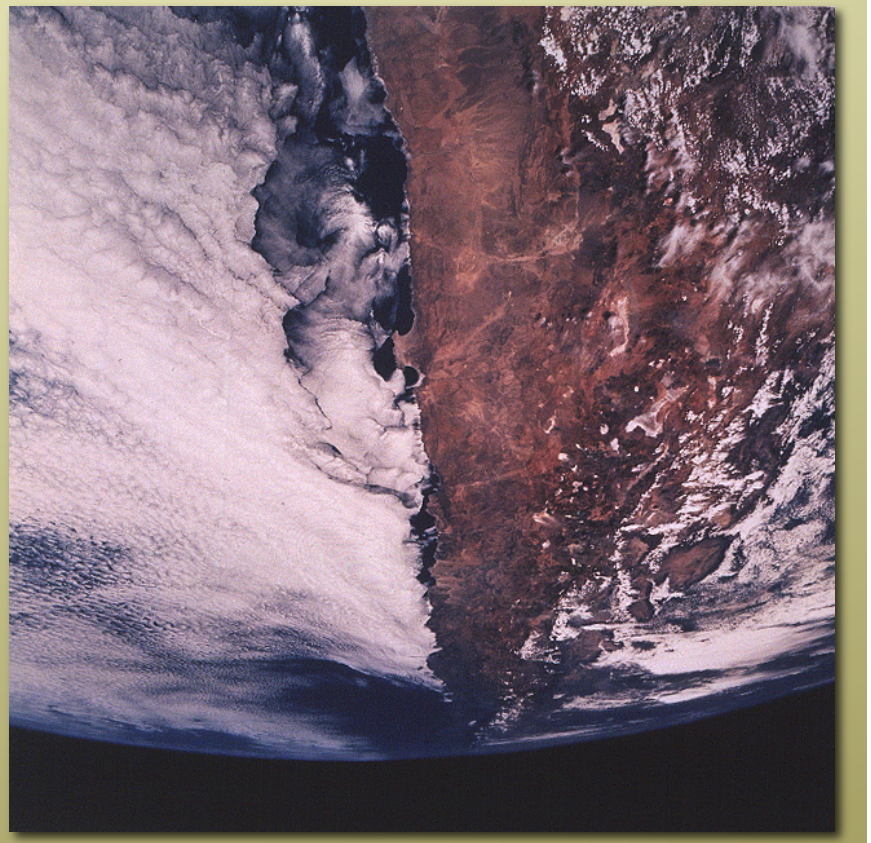
- Atacama - w Chile & SW Peru - straddles Tropic of Capricorn on Pacific Ocean edge of SAmerica
- essentially a rainless desert in the shadow of the Andes



South American Deserts

- Atacama - w Chile & SW Peru - straddles Tropic of Capricorn on Pacific Ocean edge of SAmerica

- a fog desert: note moisture laden clouds over cold Humboldt current stop at edge of continent



South American Deserts

- Atacama - w Chile & SW Peru - straddles Tropic of Capricorn on Pacific Ocean edge of SAmerica

- a fog desert: note moisture laden clouds over cold Humboldt current stop at edge of continent

- orographic precipitation is always inland at higher elevations due to adiabatic effect

Coastal cloud wall in Pan de Azucar

South American Deserts

- Atacama - western Chile & southwestern Peru - straddles Tropic of Capricorn on Pacific Ocean edge of South America

- rainless desert with plants (nephelophytes) adapted to capture fog moisture as lomas (small hill) vegetation

Tillandsia landbeckii (Bromeliaceae) - same genus as Spanish moss

South American Deserts

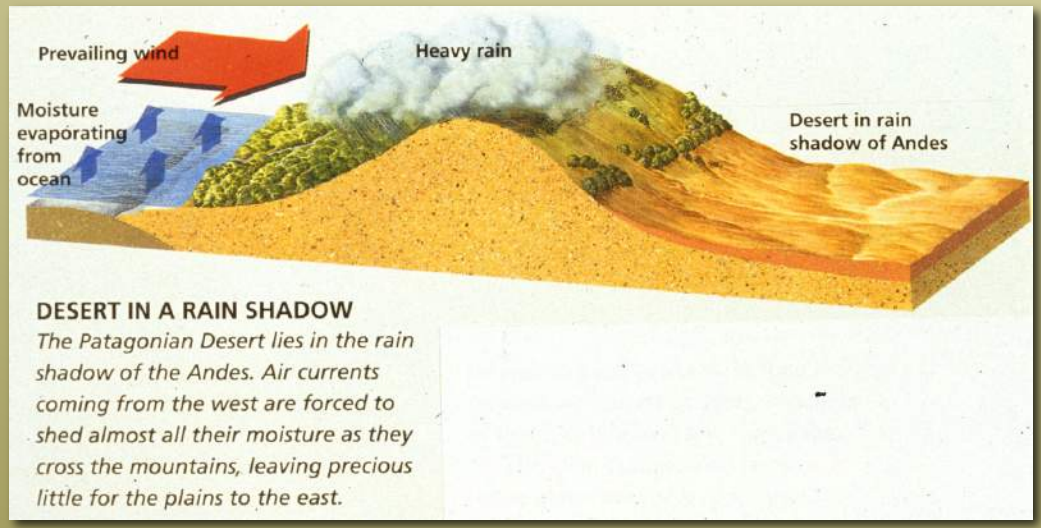
Eulychnia iquiquensis (Cactaceae), *Copiapoa* (Cactaceae) & *Euphorbia latifolia* (Euphorbiaceae)

South American Deserts

Malesherbia tocopillana (Malesherbiaceae) - family of 1 genus and 24 species restricted to west coast of South America

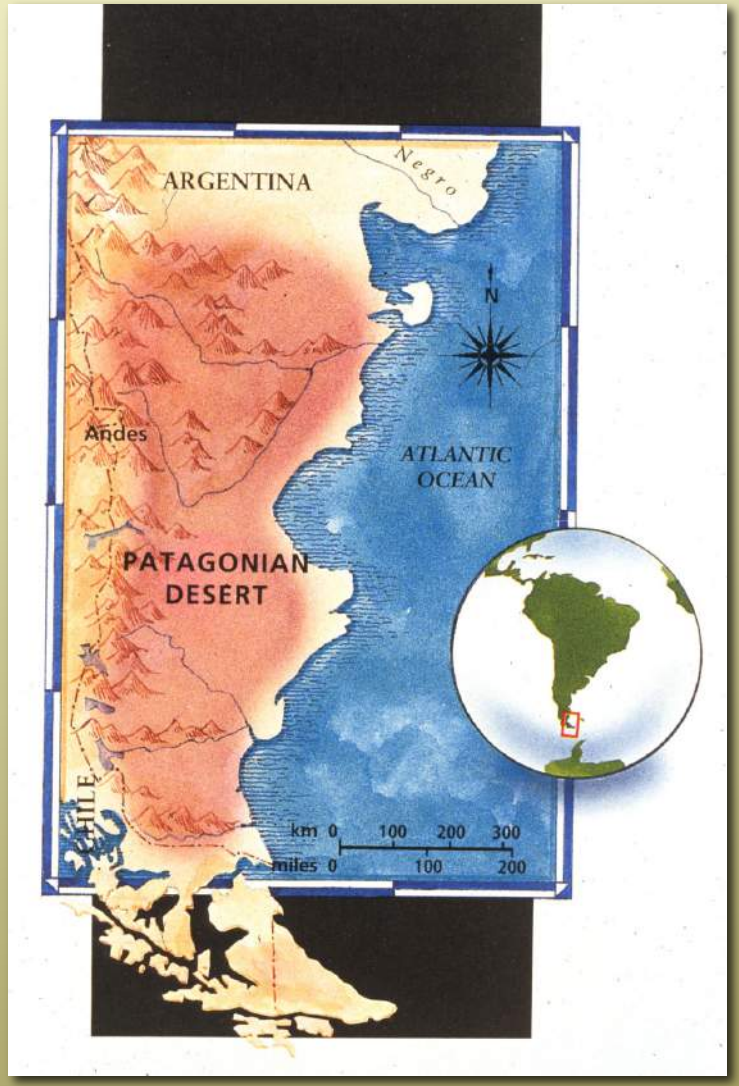
South American Deserts

- Patagonian - temperate desert formed by rainshadow of Andes



DESERT IN A RAIN SHADOW

The Patagonian Desert lies in the rain shadow of the Andes. Air currents coming from the west are forced to shed almost all their moisture as they cross the mountains, leaving precious little for the plains to the east.



North American Deserts

- 4 recognized: variation in seasonality of precipitation

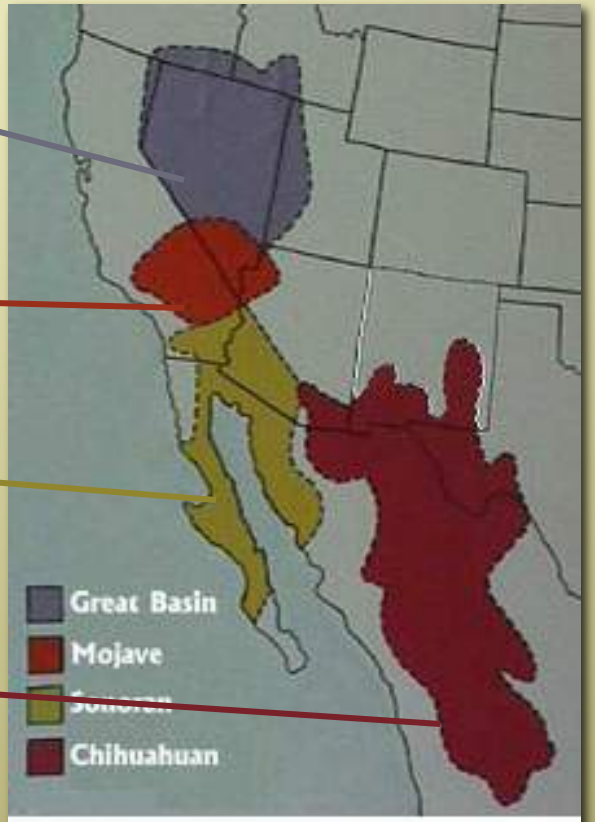
  Great Basin - cold winter desert (temperate, montane rain shadow)

  Mojave - winter rains (Mediterranean!)

  Sonoran - light winter rains and heavier summer rain (bimodal)

  Chihuahuan - only summer rain (subtropical!)

- floristically related & intergrade



Deserts of North America

North American Deserts

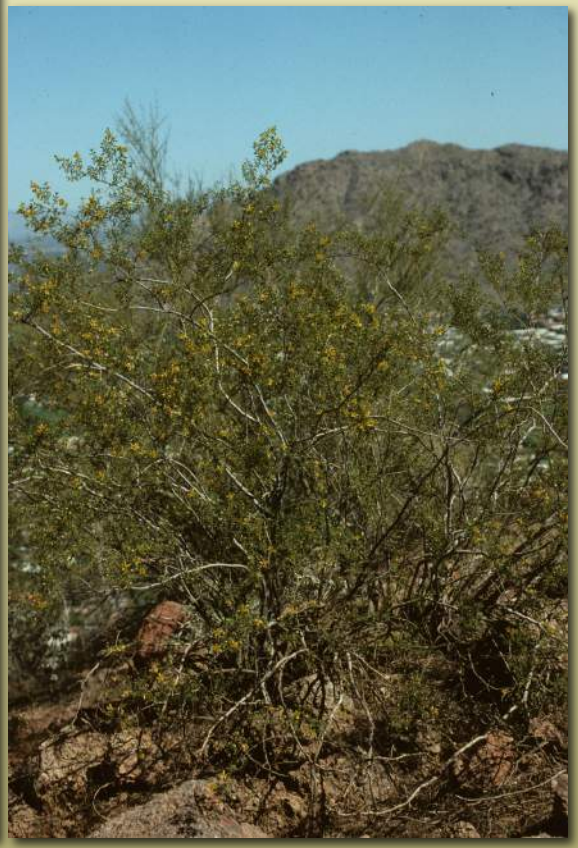
- Chihuahuan - subtropical

North American Deserts

- Chihuahuan

Yucca

Larrea tridentata (Zygophyllaceae)
creosote bush - also in South America



North American Deserts

- Chihuahuan

Acacia constricta - white thorn acacia

Flourensia cernua (Asteraceae) tarbush

North American Deserts

- Chihuahuan

Ariocarpus (Cactaceae) - Big Bend National Park, Texas

Gran Desierto del Pinacate National Park, Mexico - sand verbena (*Verbena*) & creosote

North American Deserts

- Sonoran - subtropical/Mediterranean - divided into floristic/ climatic subgroups

Carnegiea gigantea (Cactaceae) - saguaro “Queen of the Sonoran”

North American Deserts

- Sonoran

Cereus thurberi - organpipe

Opuntia bigelovii - chollo

North American Deserts

- Sonoran

Cercidium microphyllum (Fabaceae) - palo verde

North American Deserts

- Sonoran

Prosopis glandulosa (Fabaceae) - mesquite (pinole)

North American Deserts

- Sonoran

Fouquieria splendens
(Foquieriaceae) - ocotillo

North American Deserts

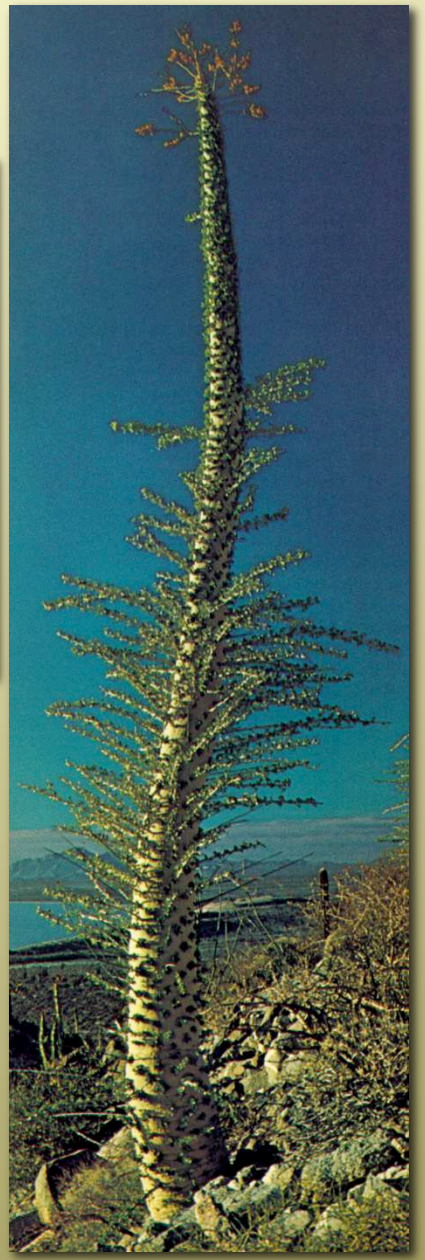
- Sonoran

Agave

Ambrosia dumosa
(Asteraceae)- bursage

Ephedra viridis -
Mormon tea

Fouquieria columnaris -
boojum (Baja)



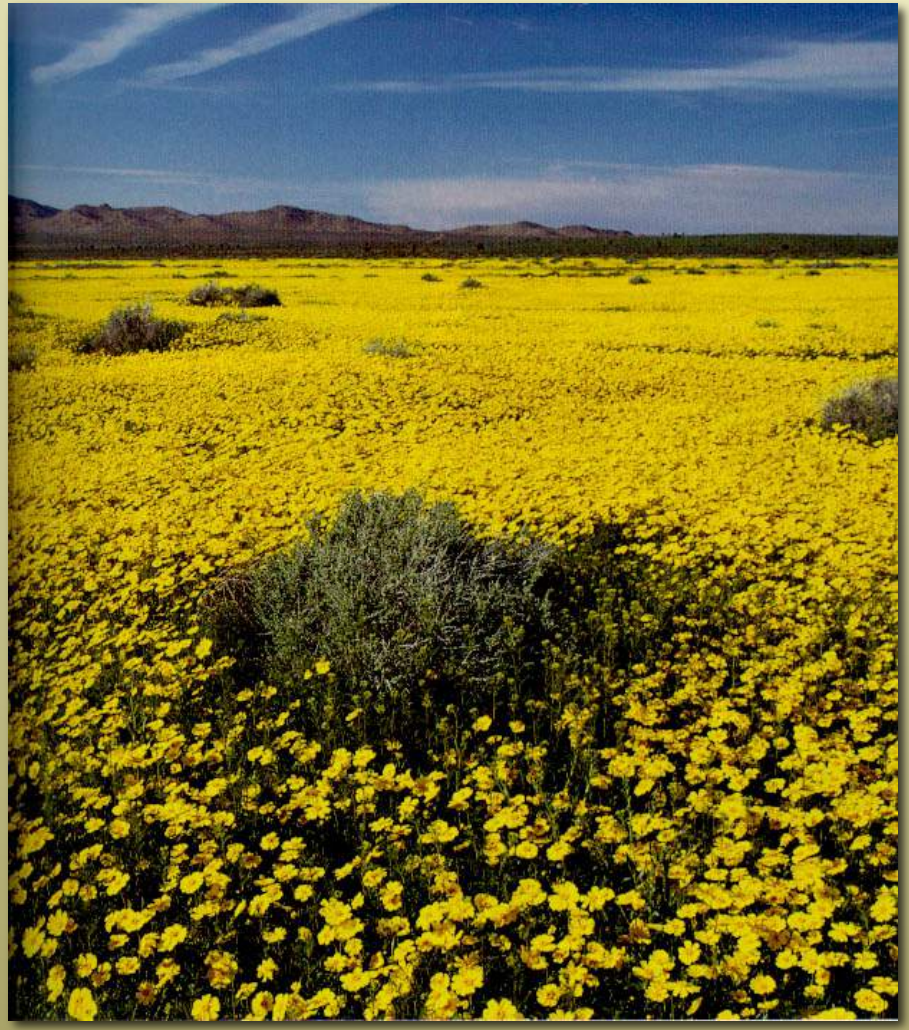
North American Deserts

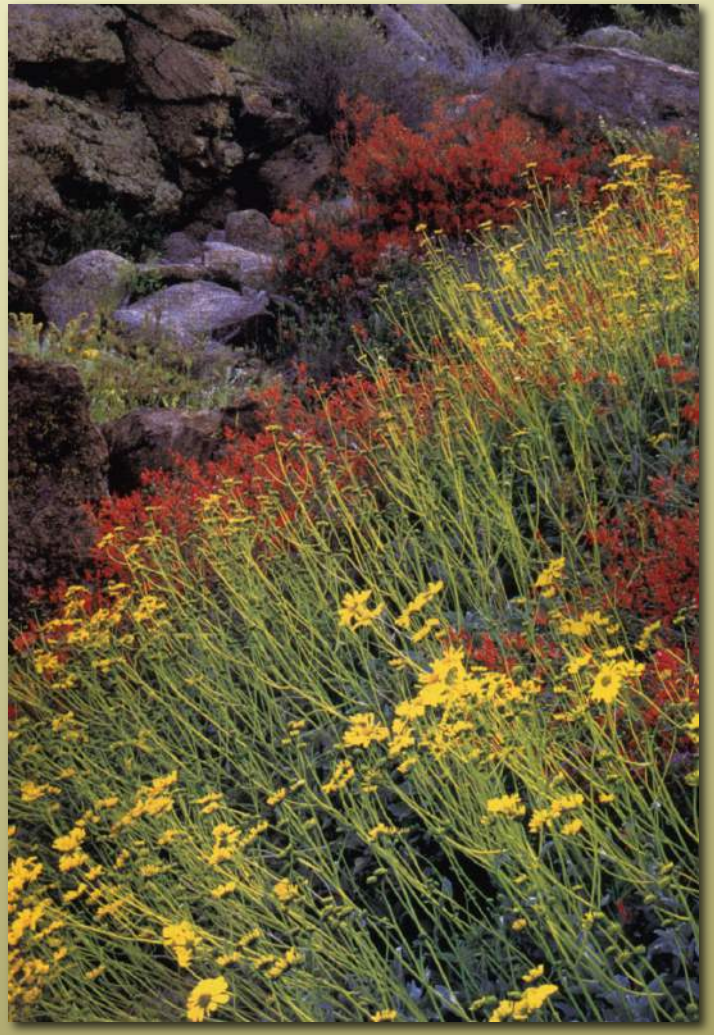
- Sonoran

Simmondsia chinensis — Simmondsiaceae
Sonoran Desert endemic

North American Deserts

- Sonoran - two rainy seasons produces diverse annual species





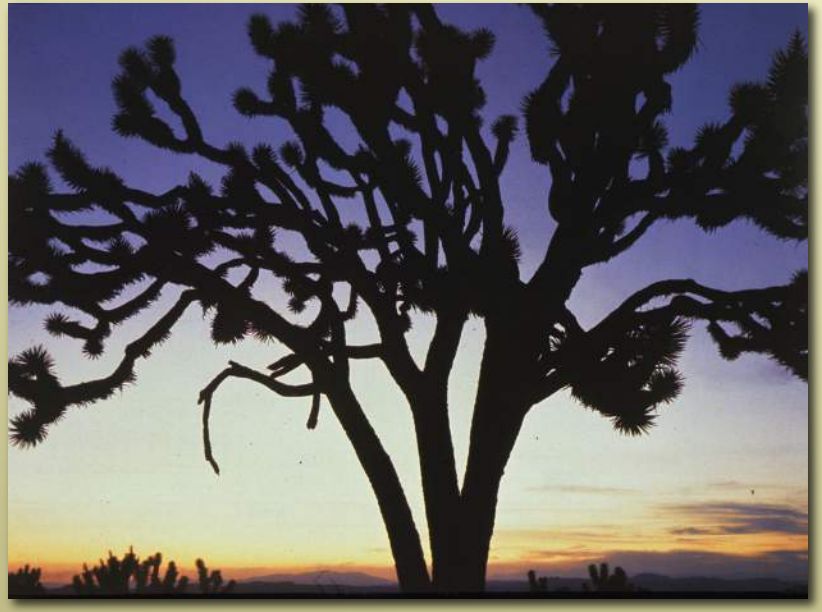
North American Deserts

- Mojave - Mediterranean (winter rain) cooler desert

Elements from the Californian Mediterranean flora are seen, but a good number of endemic species

North American Deserts

- Mojave



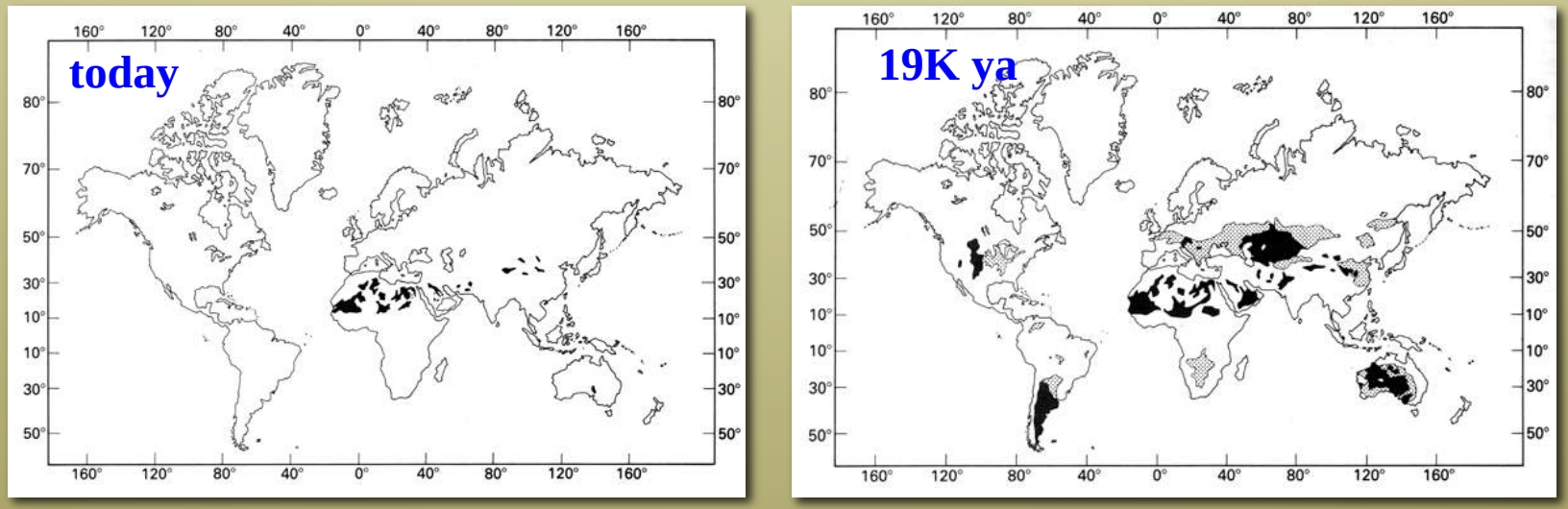
Yucca brevifolia , Joshua Tree National Park

Yucca sp.

Issues in Biogeography of Deserts

- Evolution of Desert Floras

1. Geological evidence arid times since Devonian (400mya)
2. Axelrod (1958) - desert flora originated in Miocene (24mya) and Pliocene (2.5mya)
3. Schmida (1985) and Whittaker (1977): distinctive life forms and species diversity in desert indicate even more ancient



Distribution of sand deserts

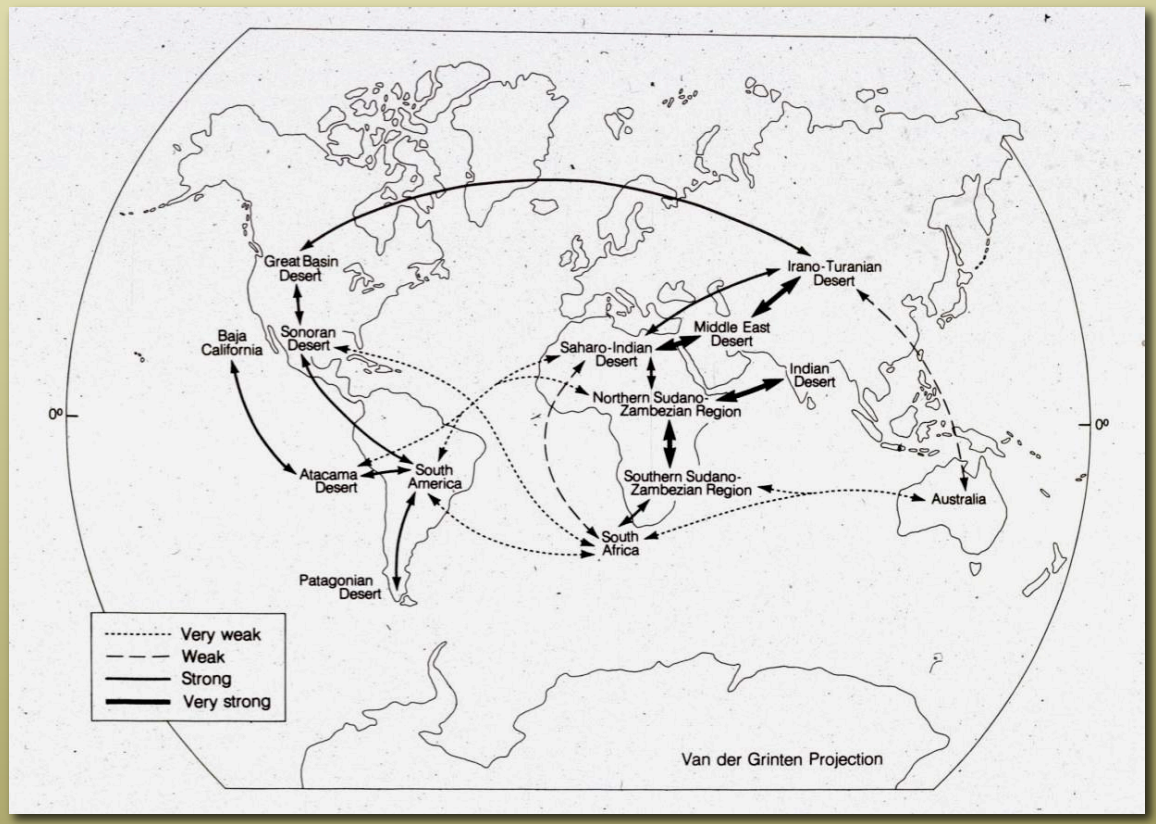
Issues in Biogeography of Deserts

- Floristic Relationships

Strong links within floristic areas

Weak links between floristic areas except N-S movement

Creosote bush in North and South America



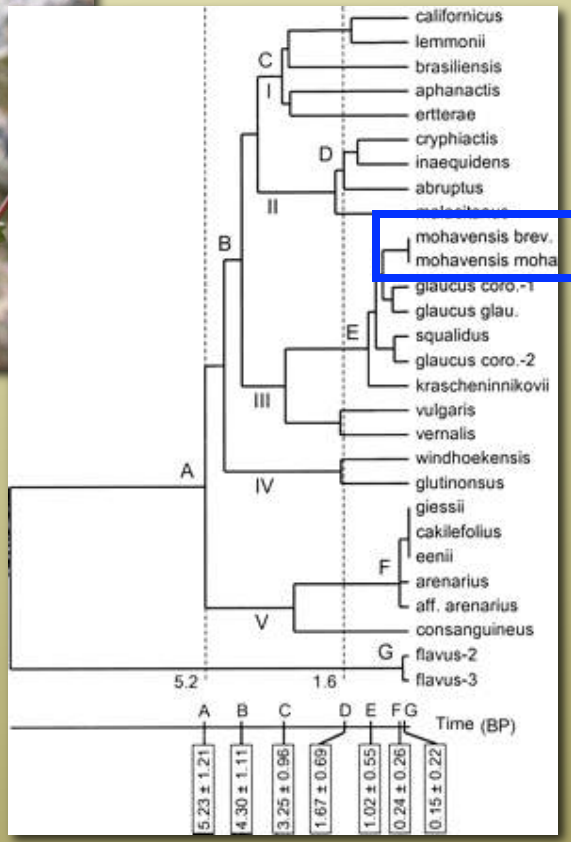
Issues in Biogeography of Deserts

- Floristic Relationships

DNA evidence for very recent long distance dispersal of *Senecio mohavensis* across Atlantic

Senecio mohavensis subsp. *mohavensis*

DNA family history



Issues in Biogeography of Deserts

- Invasives

Tamarisk invasive in Chihuahuan Desert (Big Bend National Park) - native to African deserts