

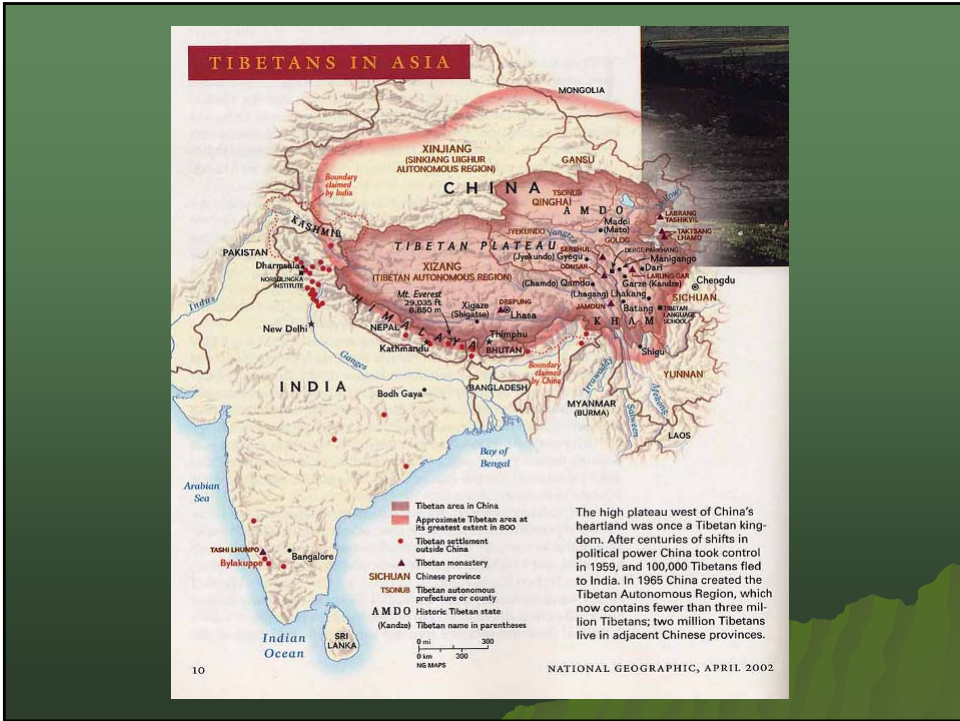
Tibetan Alpine Ethnobotany and Climate Change

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Shangri-la Alpine Botanical Garden, China
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Research Site: Eastern Himalayas





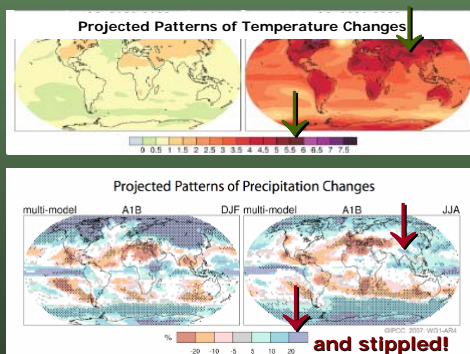


Climate Change near Khawa Karpo: five lines of evidence

1. Qualitatively, it's hot, monsoons are changing, & the glaciers are melting.
2. Repeat photographs
3. Gradient analyses
4. GLORIA plots
5. Tibetan perspectives

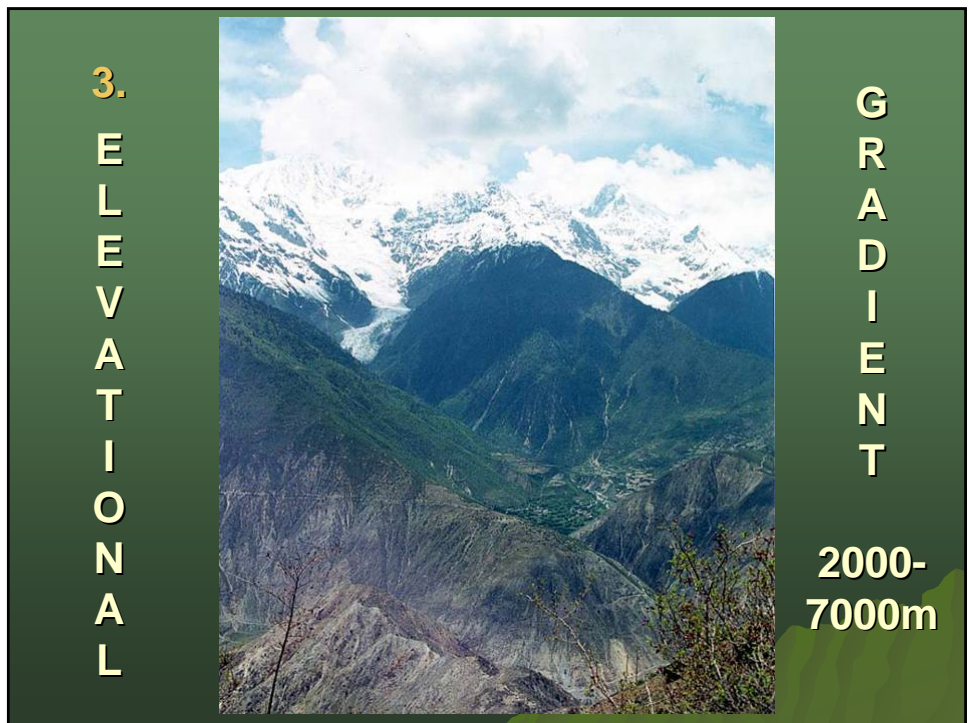
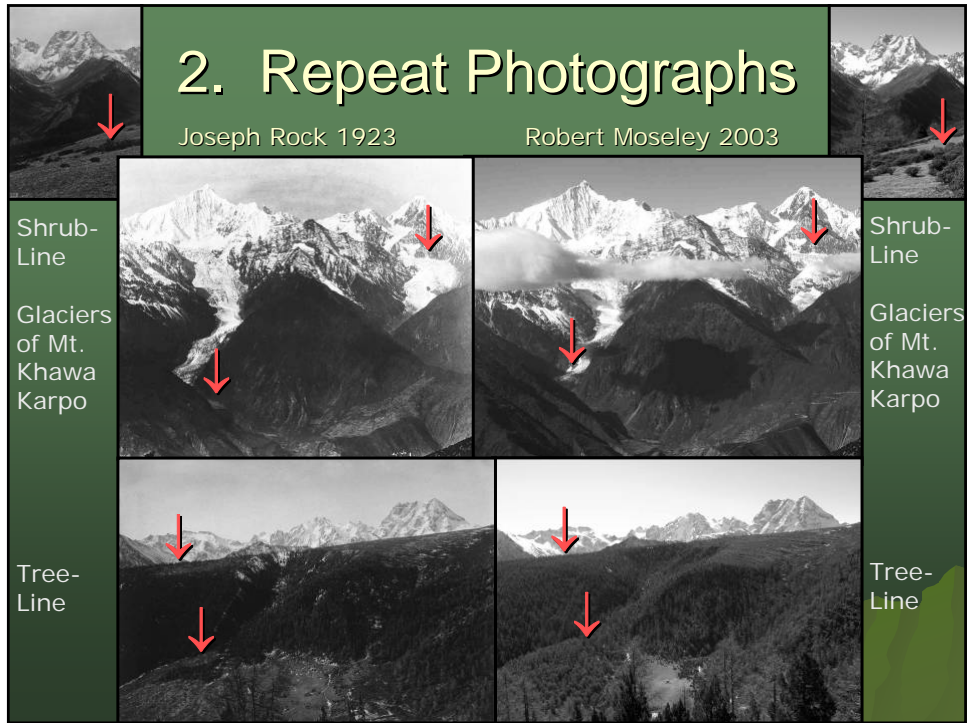
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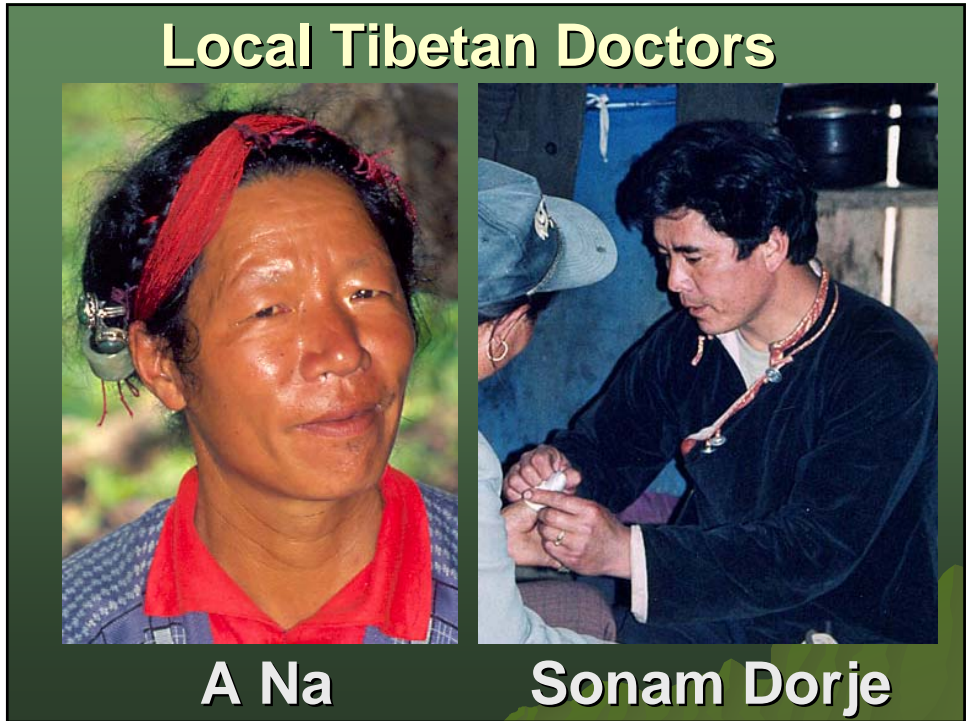
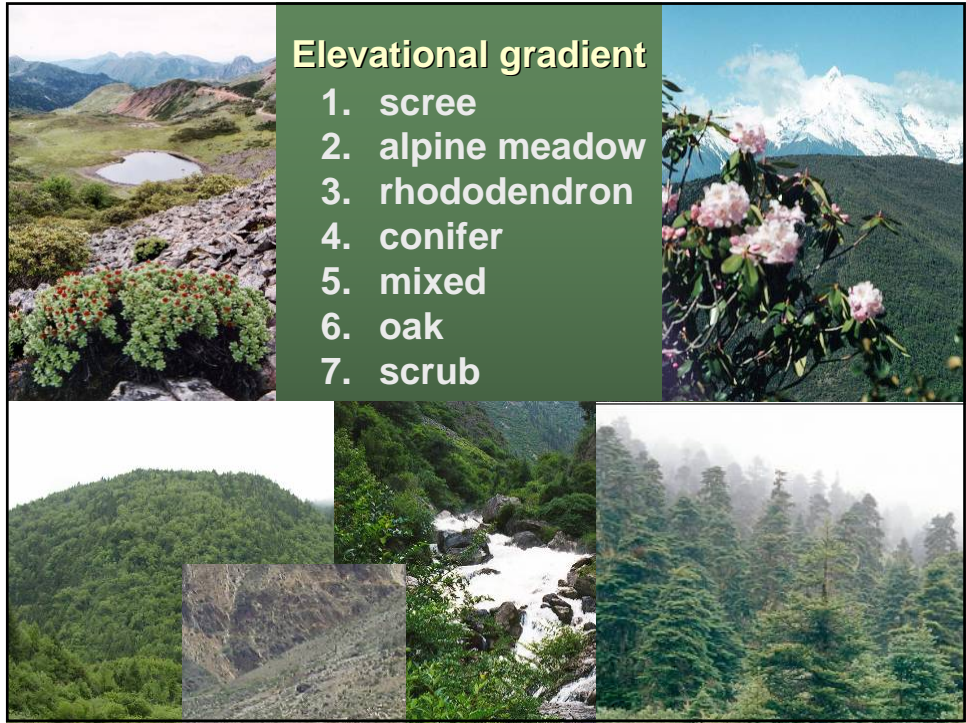
IPCC Fourth Assessment Report



5-6°C temperature increase &
20-30% precipitation increase



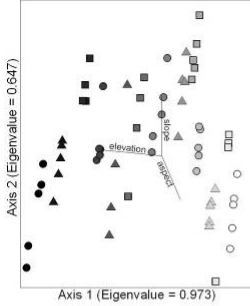




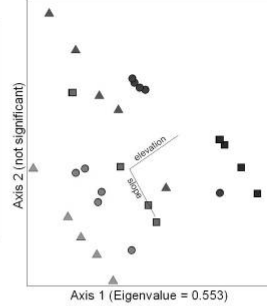
CCA Ordinations of Vegetation over Elevational Gradients (2000m-4500m)

- primary variable
 - elevation
- secondary var.
 - aspect
 - slope
- axes correlations
 - 1st 0.99-0.83
 - 2nd 0.93-0.83
 - 2nd S aspect ns

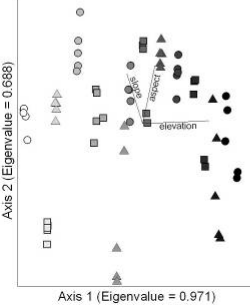
South aspect: herbs/shrubs



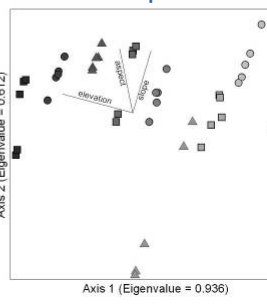
South aspect: trees



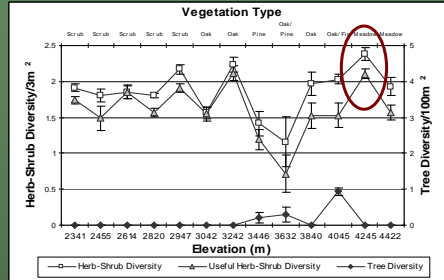
North aspect: herbs/shrubs



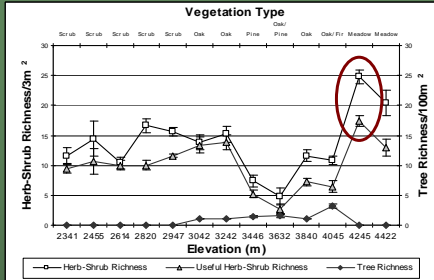
North aspect: trees



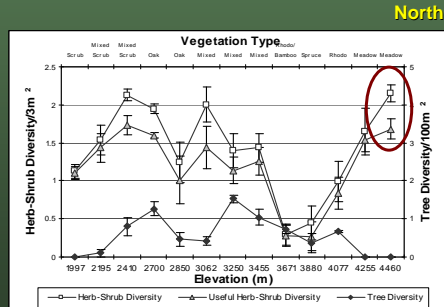
Diversity



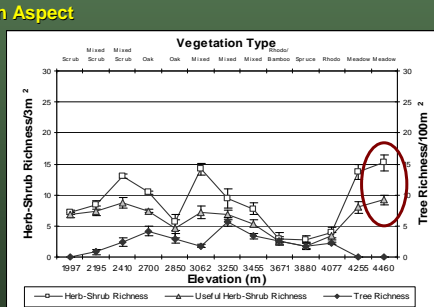
Southern Aspect



Richness

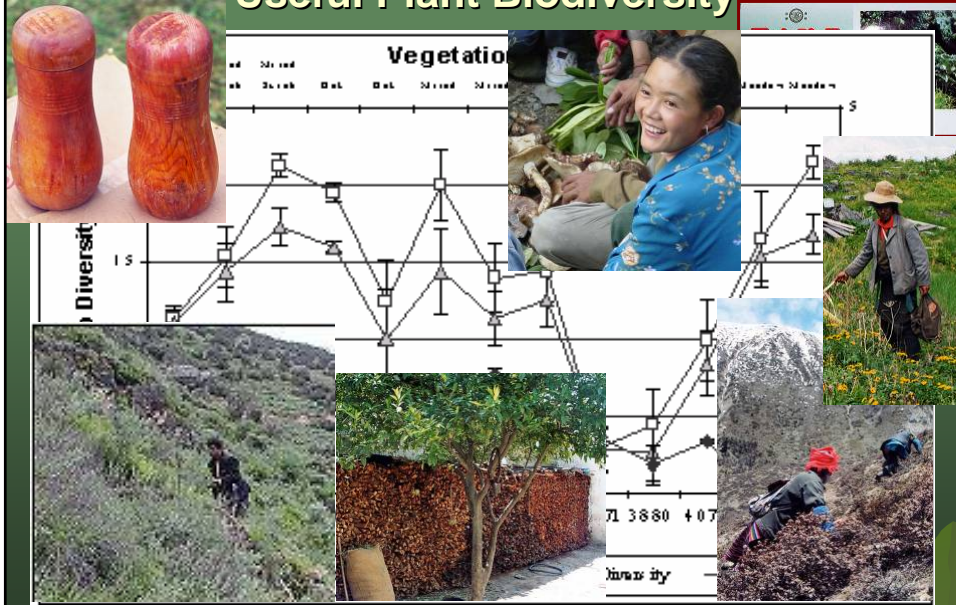


Northern Aspect



Useful plants, plant diversity and richness are all *greatest in Alpine*
ANOVAs p=0.0001 (Salick et al. 2004)

Useful Plant Biodiversity



Useful plants are directly related to biodiversity and vary with elevation
Useful plant diversity greatest in Alpine

Tibetan Doctors



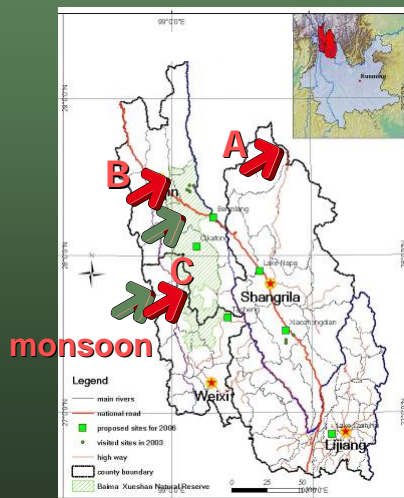
collect medicinal plants in mountains

4. GLORIA Sampling

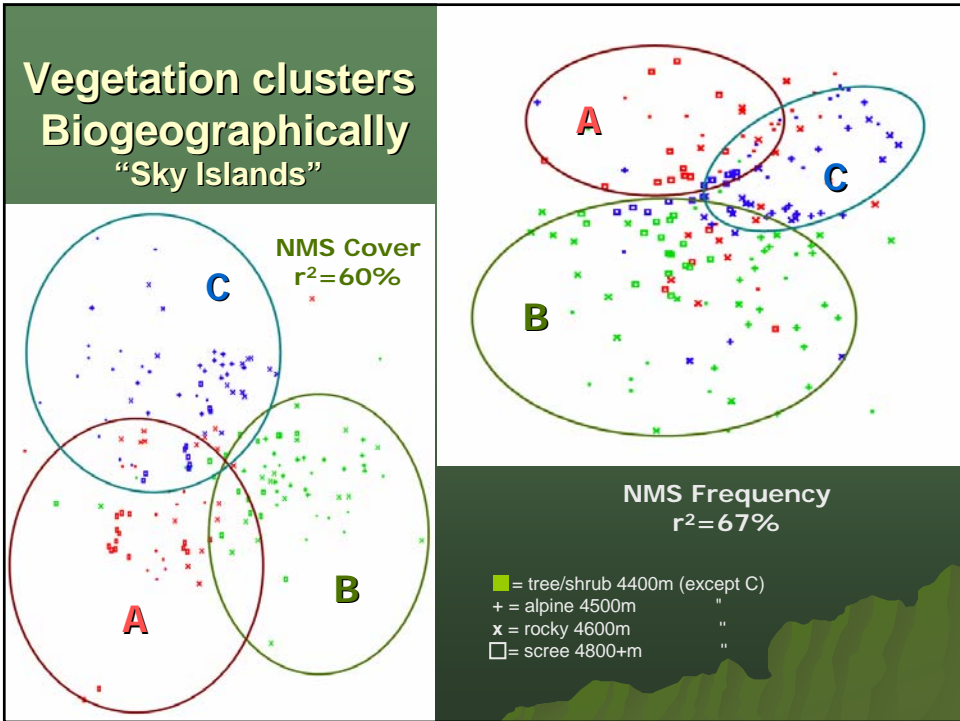
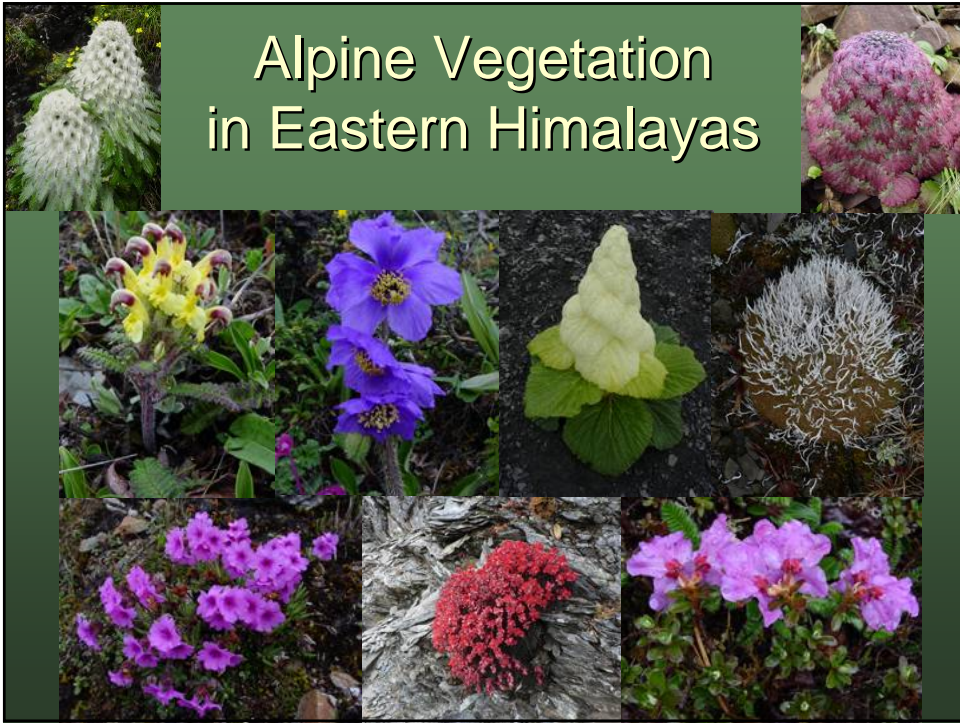
Primary variables in analyzing Tibetan climate change:
Elevation, Precipitation, **Tibetan uses of alpine plants**
and human dimensions of global climate change



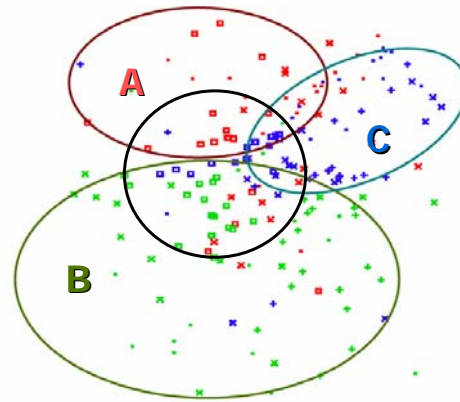
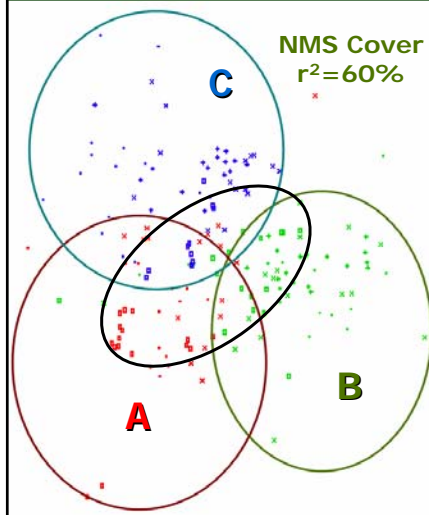
Tibetan Autonomous Prefecture NW Yunnan, China



- ◆ Da Xueshan (furthest east = least rain) **A**
- ◆ Rizila (intermediate) **B**
- ◆ Baima (intermediate)
- ◆ Ma Ji Wa (south-intermediate) **C**
- ◆ Goligongshan (furthest southwest = most rain)



Vegetation clusters biogeographically

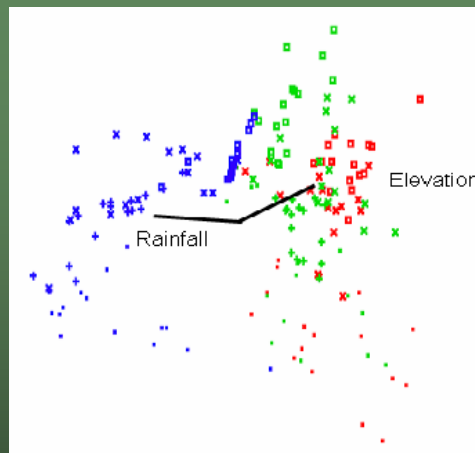
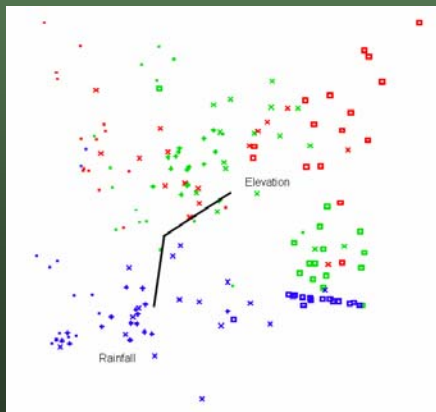


although there is similarity in high elevation vegetation, demonstrating "Arctic-Alpine" affinities.

Vegetation clusters environmentally

Precipitation and Elevation

CCA Cover: $r^2=96\%$ & 89% $p=0.001$



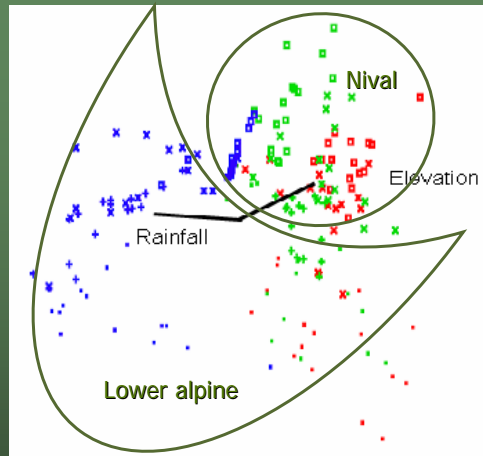
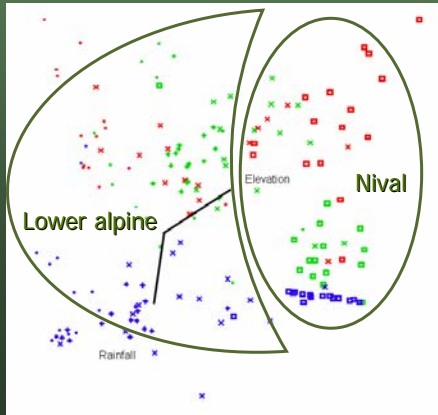
CCA Frequency: $r^2=91\%$ & 87% $p=0.001$

- = tree/shrub 4400m (except C)
- + = alpine 4500m
- x = rocky 4600m
- = scree 4800+m

Vegetation clusters environmentally

Precipitation and Elevation

CCA Cover: $r^2=96\%$ & 89% $p=0.001$

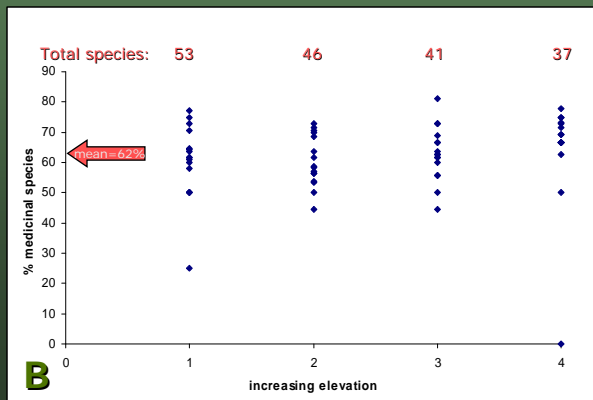
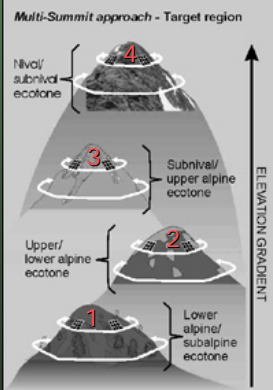
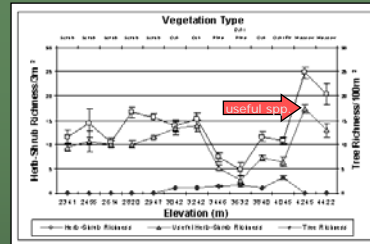


CCA Frequency: $r^2=91\%$ & 87% $p=0.001$

again, with greatest similarity in high elevation vegetation – “Arctic-Alpine” affinities.

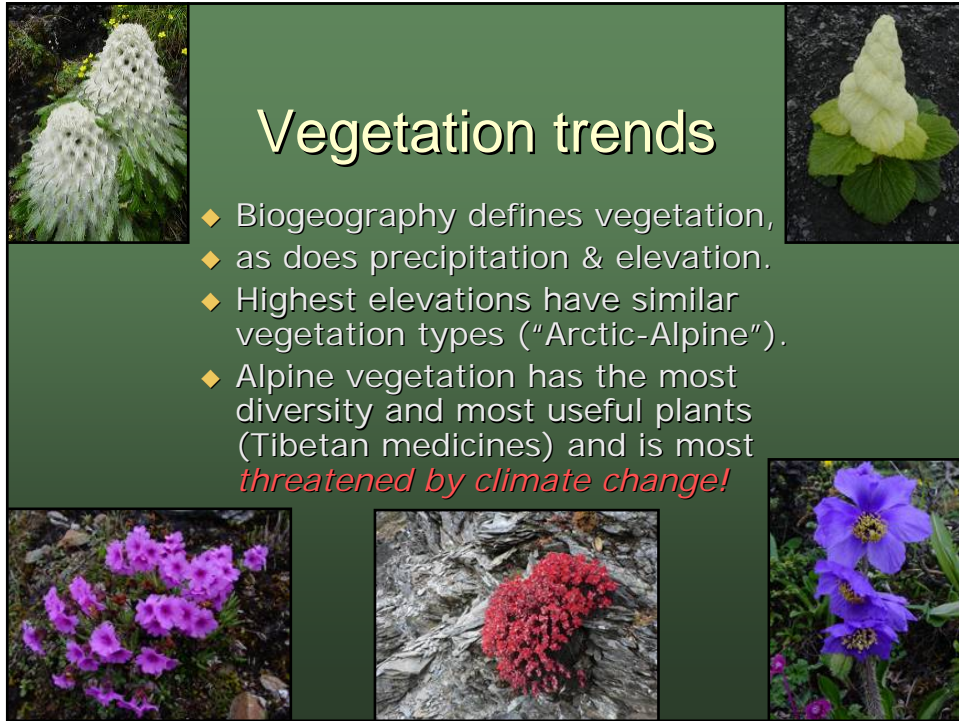


Tibetan Medicinal Plants (62% of species)




Vegetation trends

- ◆ Biogeography defines vegetation,
- ◆ as does precipitation & elevation.
- ◆ Highest elevations have similar vegetation types ("Arctic-Alpine").
- ◆ Alpine vegetation has the most diversity and most useful plants (Tibetan medicines) and is most *threatened by climate change!*



Climate Change near Khawa Karpo: five lines of evidence

1. Qualitatively, it's hot, monsoons are changing, & the glaciers are melting
 - ◆ IPCC substantiates
2. Repeat photographs
 - ◆ Glacial retreat, shrub & treeline advance
3. Gradient analyses
 - ◆ Alpine is most diverse and useful (Tibetan medicines)
4. GLORIA plots
 - ◆ Alpine is *threatened by climate change!*
5. Tibetan perspectives



Collaborating Institutions

- ◆ Missouri Botanical Garden
- ◆ Shangri-la Alpine Botanical Garden
- ◆ GLORIA, Vienna

Funding Agencies

- ◆ National Geographic Society
- ◆ The Nature Conservancy
- ◆ Danish Research Council