Treeline vs. Latitude

Rocky Mountains:

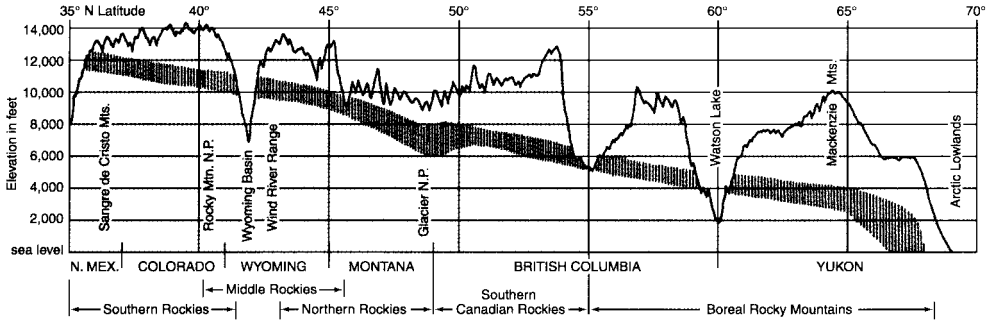

Figure 2-5. Graph showing the relationship between timberline (shaded area), the alpine zone, and latitude in the Rocky Mountains.

From: "Song of the Alpine," by Joyce Gellhorn (2002, Johnson Books, Boulder)

Global:

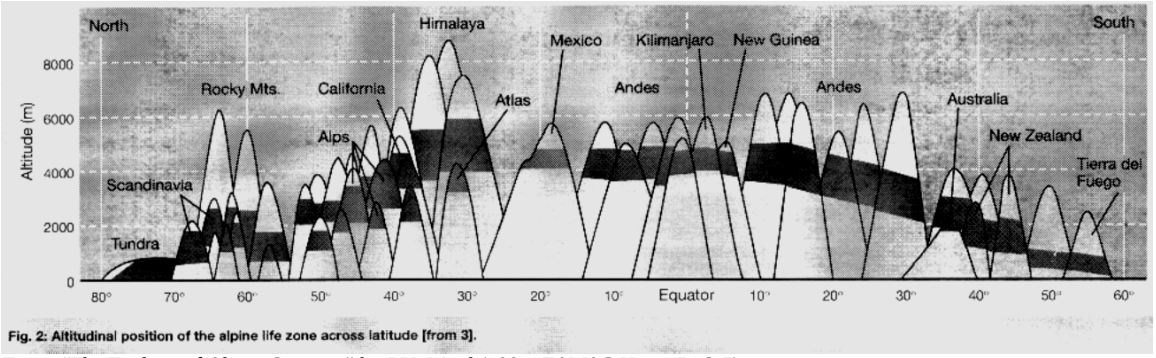

Fig. 2: Altitudinal position of the alpine life zone across latitude [from 3].

From: "The Ecology of Alpine Streams," by J.V. Ward (2001, *EAWAG News*, 54:3-5)

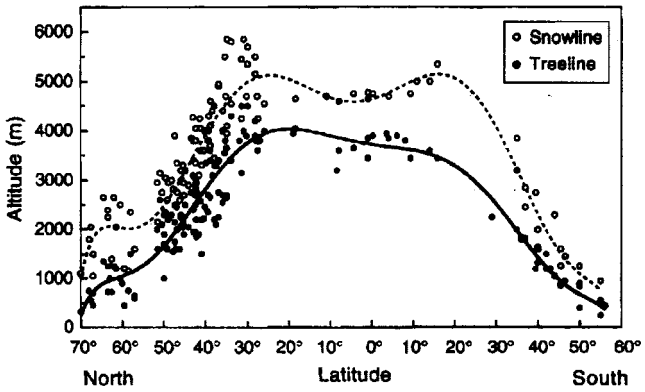

Fig. 1 The latitudinal position of treeline and snowline taken from a worldwide survey by Hermes (1955), supplemented by data from various other sources

From: "A Re-assessment of high elevation treeline position and their explanation," by C. Körner (1988, *Oecologia* 115:445-459)

The Distribution of Rocky Mtn Forest Types with Elevation and Moisture

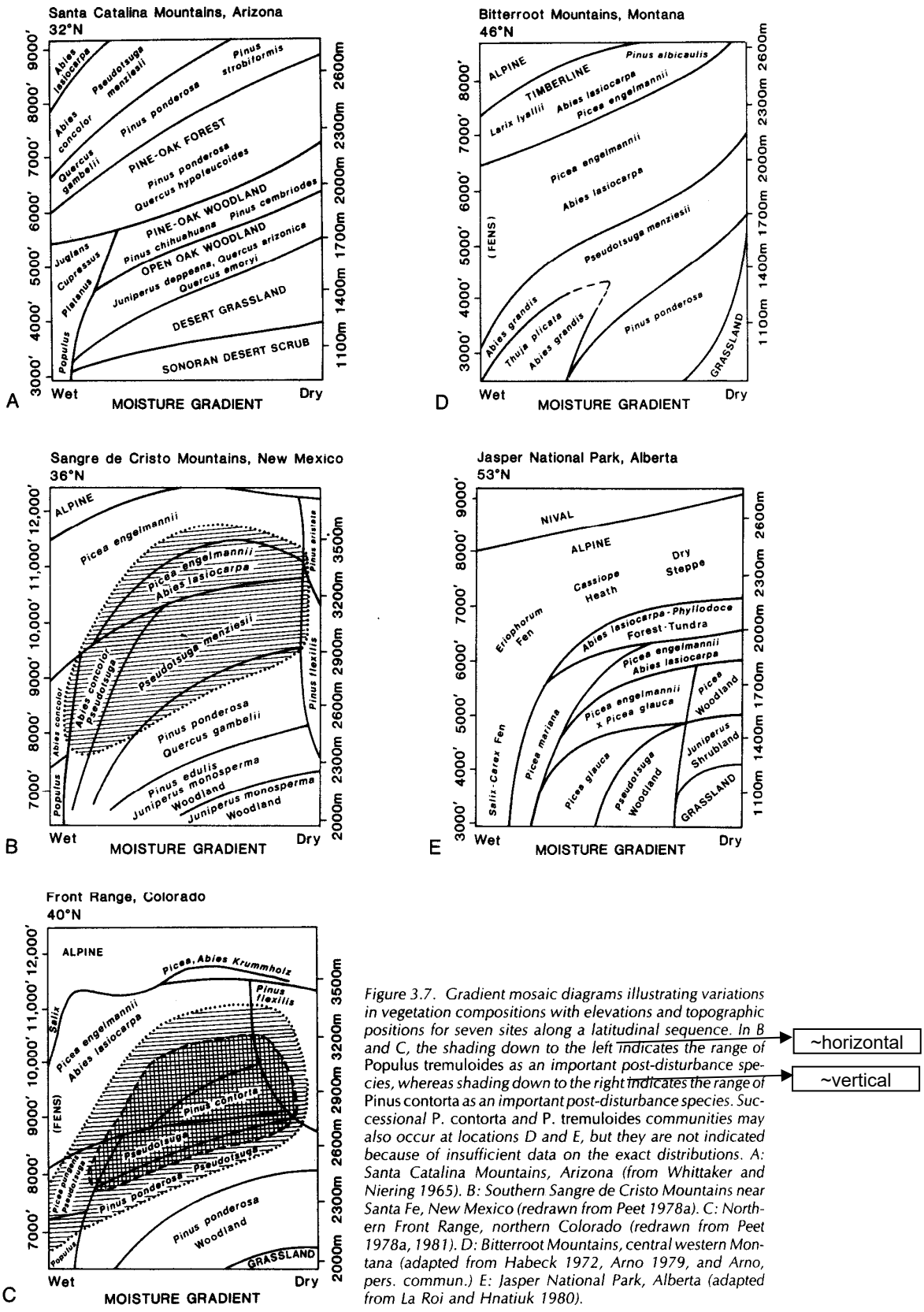

Figure 3.7. Gradient mosaic diagrams illustrating variations in vegetation compositions with elevations and topographic positions for seven sites along a latitudinal sequence. In B and C, the shading down to the left indicates the range of Populus tremuloides *as an important post-disturbance species, whereas shading down to the right indicates the range of* Pinus contorta *as an important post-disturbance species. Successional* P. contorta *and* P. tremuloides *communities may also occur at locations D and E, but they are not indicated because of insufficient data on the exact distributions. A: Santa Catalina Mountains, Arizona (from Whittaker and Niering 1965). B: Southern Sangre de Cristo Mountains near Santa Fe, New Mexico (redrawn from Peet 1978a). C: Northern Front Range, northern Colorado (redrawn from Peet 1978a, 1981). D: Bitterroot Mountains, central western Montana (adapted from Habeck 1972, Arno 1979, and Arno, pers. commun.) E: Jasper National Park, Alberta (adapted from La Roi and Hnatiuk 1980).*

~horizontal

~vertical

From: "Forests of the Rocky Mountains," by R.K.Peet (Chapt 3, in: M.G. Barbour & W.D. Billings. 1988. *North American Terrestrial Vegetation.* Cambridge Univ Press.)

Macro and Mesoscale Factors Controlling Alpine Vegetation

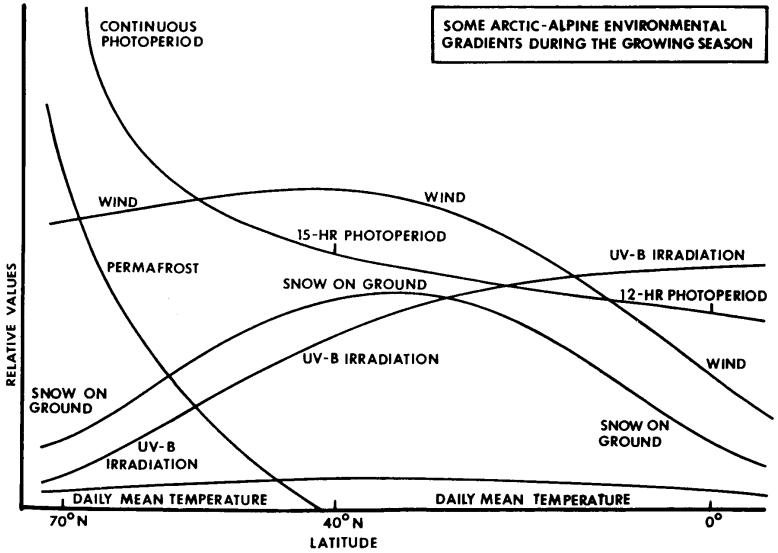

Figure 13.1. Relative values for six principal environmental factors in arctic and alpine ecosystems along a latitudinal gradient from the equator to the Arctic. The factor that changes the least along the gradient is daily mean air temperature. Factor combinations differ considerably at any given latitude (from Billings 1979).

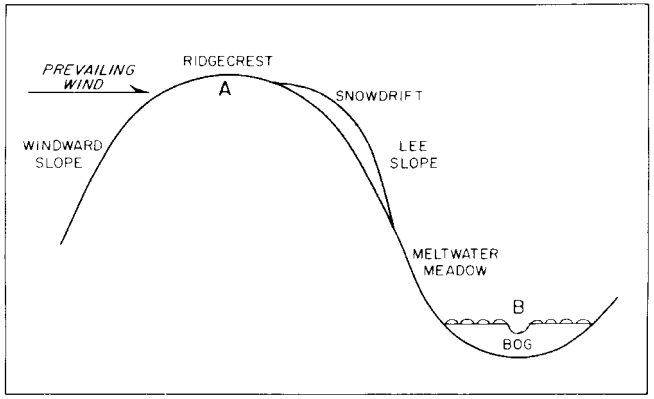

Figure 13.4. Diagram of a typical alpine mesotopographic gradient (adapted from Billings 1973).

From: "Alpine Vegetation," by W.D. Billings (Chapt 13, in: M.G. Barbour & W.D. Billings. *North American Terrestrial Vegetation.* Cambridge Univ Press.)

Raunkiaer Life Forms

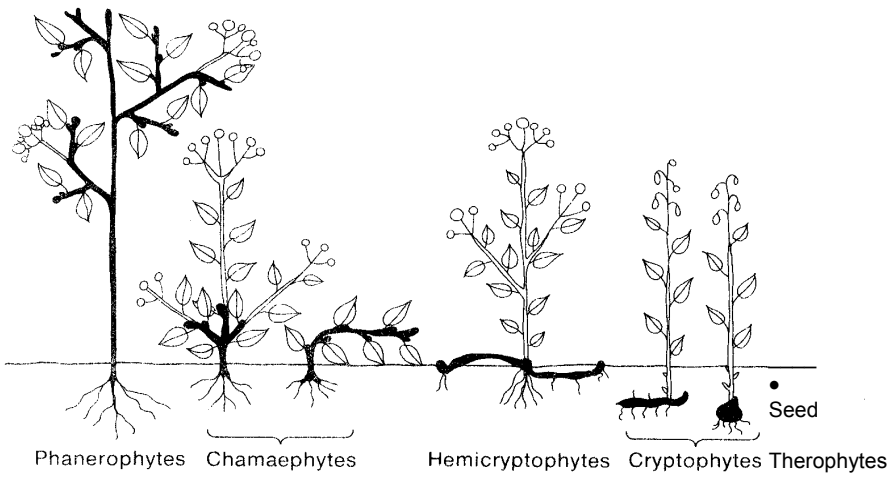

Figure 6-3 Diagrammatic representation of Raunkiaer's life forms. Unshaded parts of the plant die back during unfavorable seasons, while the solid black portions persist and give rise to the following year's growth. Proceeding from left to right, the buds are progressively better protected (after Raunkiaer 1937).

conditions (Raunkiaer 1934). He distinguished five principal life forms (Figure 6-3):

phanerophytes (from the Greek *phaneros,* visible) carry their buds on the tips of branches, exposed to extremes of climate. Most trees and large shrubs are phanerophytes. As one might expect, this plant form dominates in moist, warm environments where buds require little protection.

chamaephytes (from the Greek *chamai,* on the ground, dwarf) comprise small shrubs and herbs which grow close to the ground (prostrate life form). Proximity to the soil protects the bud. In regions of heavy snowfall, the buds are protected beneath the snow from extreme air temperatures. Chamaephytes are most frequent in cool, dry climates.

hemicryptophytes (from the Greek *kryptos,* hidden) persist through the extreme environmental conditions of the winter months by dying back to ground level where the regenerating bud is protected by soil and withered leaves. This growth form is characteristic of cold, moist zones.

cryptophytes are further protected from freezing and desiccation by having their buds completely buried beneath the soil. The bulbs of irises and

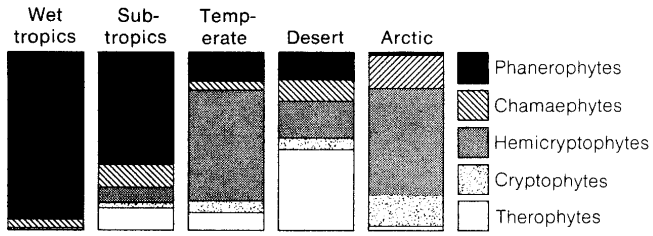

Figure 6-4 Proportion of plant life forms, classified according to Raunkiaer (1934, 1937), in various climatic regions (after compilations of Richards 1952, Dansereau 1957, Daubenmire 1968).

daffodils are representative of the regenerating buds of cryptophyte plants. Like hemicryptophytes, cryptophytes are also found in cold, moist climates.

therophytes (from the Greek *theros,* summer) die during the unfavorable season of the year and do not have persistent buds. Therophytes are regenerated solely by seeds, which resist extreme cold and drought. The therophyte form includes most annual plants and occurs most abundantly in deserts and grasslands.

The proportional occurrence of Raunkiaer's life forms in the floras of various climatic regions is summarized in Figure 6-4. Life form and climate go closely together. Phanerophytes dominate vegetation forms in warm, moist environments. They are progressively replaced by chamaephytes, hemicryptophytes, and cryptophytes in temperate and arctic regions. Deserts are distinctive in having a large proportion of therophytes.

From: "Ecology," by R.F. Ricklefs (1997, 2nd ed., Chiron Press, NY)