CALIFORNIA BOTANISTS IN SOUTH AFRICA

by Jon Keeley & Melanie Keeley

"Convergent evolution" is a hypothesis which predicts that similar environments will result in similar plant adaptations. Because the five mediterranean-climate regions of the world (California, Chile, the Cape region of South Africa, southwestern Australia, and the Mediterranean) have a similar regime of mild, wet winters and hot, dry summers, these areas are often held up as classic examples of this phenomenon.

The chaparral-like shrublands of southwestern South Africa are known locally as "fynbos," an African word literally translated as "fine bush." The rugged terrain of this region, covered with fynbos and bordering the ocean, results in a landscape markedly reminiscent of Southern California. And, as with our own landscape, wildfires are a common summer and fall event. Many fynbos plants rival the California chaparral in their resilience to, even dependence on, frequent, seemingly destructive conflagrations. Some fynbos shrubs resprout after fire from specialized basal burls or lignotubers and many others have seeds that remain dormant for decades but germinate in profusion following fire.

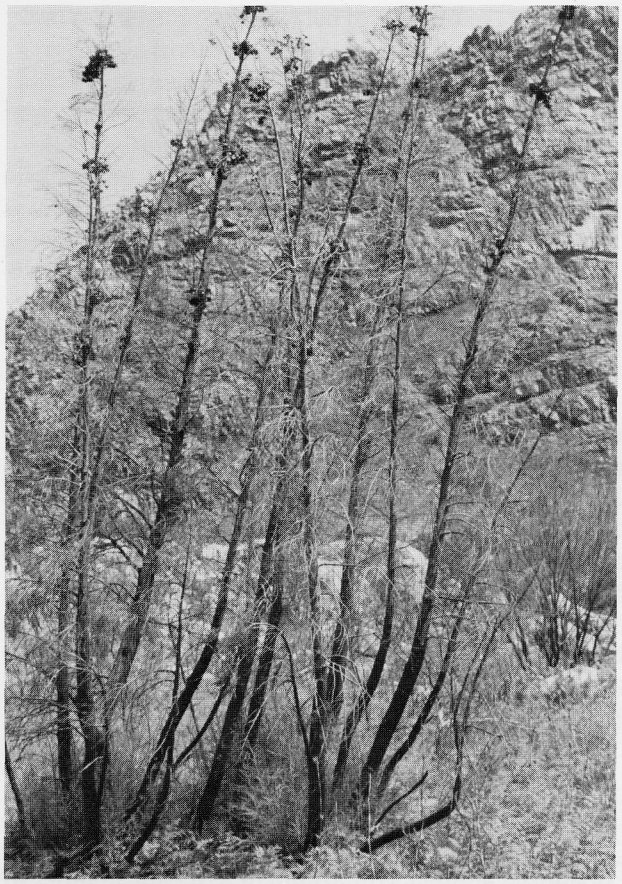
Burned shrubs of a South African fynbos species in the *Proteaceae* family. Photographs by the author.

Nevertheless, the floras of California and South Africa are quite distinct. No species are shared in common and only a few genera, e.g., *Rhus* and *Rhamnus*, are found in both regions. Many plant families that abound in South Africa are non-existent in California; in fact, the largest and most abundant plant families in the Mediterranean climate region of South Africa are poorly developed elsewhere. Two of the largest families in South Africa, the Restionaceae and the Proteaceae, are seldom important in other parts of the world, including the rest of the African continent. The flora of the Cape region also has a number of small, entirely endemic plant families found nowhere else in the world.

Botanists recognize this uniqueness by designating 35,000 square miles of the region as its own floristic province, the Cape Floristic Province of South Africa. By contrast, the entire Northern Hemisphere is considered to be included in one of the seven Floristic Provinces of the world (according to some systems), reflecting the fact that the important plant families and many genera are held in common between North America, Europe, and Asia.

Worldwide, the Cape region is also well known as a center of exceptionally high species diversity; the number of plant species per square mile is more than five times greater than our own diverse flora. Identification "nightmares" in California, e.g., *Arctostaphylos*, with approximately sixty species, pale in comparison to the Cape, where an area a fraction the size of California contains ten genera of woody plants, each with more than 100 species. *Erica*, the genus of heather found in northern Europe (and gardens worldwide) has over 600 species in the Cape region. The lack of floras with keys makes identification of species difficult even for local specialists.

Theories to account for the high species diversity in the Cape region are almost as diverse as the flora. One credible theory concerns the very unusual nutrient-deficient soils of the region. It was refreshing to hear the soils of our Southern California chaparral referred to as "nutrient-rich," but relative to the fynbos this is a reasonable description. Fynbos soils are in many respects like highly leached beach sand. It has been proposed that this nutrient deficiency prevents any single species from dominating a site, for nowhere does one see the California



Recently burned trees with basal resprouting of the fynbos species, *Widdringtonia nodiflora* (*Cupressaceae*), (left), the ecological equivalent of our California chaparral closed-cone cypress except, unlike our cypress, *Widdringtonia* resprouts after fire. A recently burned *Widdringtonia* tree trunk with open cones (right).

equivalent of vast monotonous stretches of chamise; rather, each stand of fynbos consists of a varied mixture of species, none of which dominates to the exclusion of all others.

Nutrient-deficient soils may also account for other differences between chaparral and fynbos. One such phenomenon is the extremely high incidence in fynbos of "myrmechory", or seed dispersal by ants. In California we have only one well documented instance of myrmechory, in *Dendromecon rigida*, or bush poppy, whose seeds produce an appendage which is unnecessary for successful germination but a highly sought-after food source for ants.

After seeds are dispersed from the follicles and fall on the ground, ants collect and bury them, eventually removing and eating the appendage but leaving the seed unharmed. In South African fynbos, fully thirty percent of the flora, including the most abundant species, are myrmechorous; thus on any given site the vast majority of fynbos plants relies on ants for seed dispersal.

There is no consensus among scientists as to why myrmechory, relatively rare in the rest of the world, is so common in the fynbos. One hypothesis is that because the soils lack phosphorus and nitrogen, seeds suffer a tremendously high rate of predation from insects and animals seeking nutrients. Myrmechory is thus an advantage for the plant, since ants rapidly collect seeds on the soil surface and hide them from predators.

Nutrient-deficient soils have also been linked to difference between fynbos and chaparral responses to wildfires. Both vegetations are characterized by a short-lived, temporary "fire-follower" flora immediately after the fire. In chaparral this is dominated by wildflowers such as *Phacelia, Lotus, Emmenanthe*, and other species that generally arise from seeds. In fynbos, however, these "fire-followers" tend to be perennial lilies and irises, many from genera familiar to gardeners: *Gladiolus, Amaryllis, Pelargonium*. Perhaps these geophytic perennials succeed in the impoverished fynbos soils because they can accumulate and store nutrients in bulbs and corms.

We went to the fynbos expecting familiarity born of a mild Mediterranean climate and "convergent evolution." And while we did indeed find striking similarities to our own California chaparral, it was the richness of differences that was our reward for travelling halfway round the globe.

Jon Keeley & Melanie Keeley, Occidental College, Los Angeles, CA 90041.

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