The Canary Islands: Continents in Miniature, Lands of Myth

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Blessed as they are with one of the mildest climates on earth, the ancient Greeks and Romans well knew the Canaries as the "Fortunate Islands". Local legend has it that this was the location of the Garden of the Hesperides, from which Hercules stole the golden apples on the same voyage which gave the name "Pillars of Hercules" to the Strait of Gibraltar. The name "Canary", according to Pliny the Elder, came not from the bird, but from the sighting by a second century BCE Roman expedition of a large number of wild dogs (*canes* in Latin). Plato believed that these seven submarine peaks, peopled by tall light-skinned peoples, many with blue eyes and blond hair, were all that remained of Atlantis. The geographer Ptolemy fixed the 0 meridian (the "end of the world") at the western tip of Hierro, where it remained until it was moved to Greenwich in 1833. Columbus made his last landfalls here during each of his four voyages to discover the New World, and is said to have been in love with a local noblewoman, the Countess Beatriz de Bobadilla. I made my two voyages to Gran Canaria and Tenerife by air during the first and last weeks of 2007.

Today, the archipelago is Spain's farthest overseas community, a two-hour flight south along Africa's west coast between latitudes 27 and 29 degrees north. The eastern islands of Fuerteventura and Lanzarote, being only 115 kilometers from the Saharan Desert, are mostly arid. The central and western islands, more influenced by the prevailing humid *vientos alisios* (westerly winds), are at least partly tropical paradises. La Palma is known as the "Garden Island" and Santa Cruz deTenerife has an annual relative humidity of 63% (AEMET, 2008). Botanically the archipelago, along with Portuguese Madeira, Azores, Cape Verde and other Atlantic island groups, comprise the Macaronesian Floristic Province, which is closely related to both the Saharo-Arabian and the Mediterranean. The Canaries share species in common with Ethiopia and the Arabian Peninsula, but the total of 511 endemisms, 25% of the total of 1,995 species (Gobierno de Canarias, 2004) makes it one of the world's most unique botanical treasure houses. In recognition of this, 40.4% of the 7,450 square kilometers of total land area is protected in national parks and preserves, one of the highest ratios in the world (Gobierno de Canarias, 1995).

History and People

The origin of the native inhabitants, Amazigh-speaking ancestors of the modern Berbers of North Africa known as the *Guanches*, has always been a mystery. It was long thought that they arrived in primitive boats from the mainland during the first millenium BCE. However, the first modern European re-discoverers, the Genoese in 1312 and the Portuguese in 1335, found no boats and no sign of any communication between the islands. The Stone-Age inhabitants of each seemed to speak a different language, but were observed to fall into two general groupings: naked cave-dwelling hunters and gatherers and agrarian societies wearing tailored skin clothing, living in villages of round stone houses. The first conqueror and colonist, the French Norman Bethancourt in 1402, quickly subdued the natives of Lanzarote and Fuerteventura and converted them to Christianity. Both he and the later Spanish invaders met with limited success against the warlike and well-organized tribes of the larger islands. It was not until after the fall of Moorish Granada in 1492 that the Spanish were finally able to concentrate enough military force to succeed. After a struggle lasting 94 years the last *mencey* (king) of Tenerife, Bentor, threw himself off a cliff on July 25, 1496 rather than become a Spanish slave. Many of the surviving Canarians were eventually rounded up and exiled as colonists to the New World. The rest were absorbed into the European population.

There are still many descendants of Bethancourt and the original Spanish and Portuguese settlers, but many modern Canarians are ethnically Venezuelans, Cubans and other Latin Americans, whether of Canarian origin or not, who arrived in a sort of reverse migration. The islands' popularity with vacationing Europeans, and the many expatriate Germans, Brits, Finns and Swedes who have retired there gives them a distinctly cosmopolitan flavor. The aboriginal *Guanche* culture has all but vanished, except what has been preserved for instance at the pottery making centers on Gran Canaria and the reconstructed *Guanche* village on Tenerife. The 800 place names and 300 words and phrases recorded by Sabin Berthelot in 1845 are all that have been preserved of their language (Wendt, 1962), but there are quite a few excellent ethnological museums. Just as earthquakes, volcanism, storms and fire have shaped the physical environment of the islands, the influx of people continues to shape the society.

Climate and Natural History

In addition to the humidity gradient from east to west across the archipelago, another exists from north to south on each island. Due to the influence of the humid *vientos alisios*, the northern windward side of each island is much wetter. Clouds tend to pile up against the slopes, condensing almost daily into dense fogs which obscure the peaks from below and form a sea of clouds when seen from above. Each of the western islands has a wet and a dry side and on a clear day, one can see from island to island. There is an additional altitudinal gradient. The first 600 meters or so above sea level

is arid, with 150-250 mm of annual precipitation (AEMET, ibid) and dominated by succulents and xerophytic woody plants, the *tabaibal-cardonal* (Fig. 1). Climbing into the fog belt from about 600 to 1,600 meters the vegetation becomes increasingly lush, and is known as the *monteverde* (Fig. 2) Mixed shrubby woodlands, including the *fayal-brezal* or Macaronesian heath, distinguished by *fayas* ("firetree", *Myrica fava*, Myricaceae) and *brezos* ("tree heath", *Erica arborea*, Ericaceae) dominate the slopes up to about 1200 meters. Above that great forests mostly composed of endemic Canary Island pine (*Pinus canariensis*, Pinaceae) comprise the *corona forestal* or "forest crown" (Fig. 3). The mass of leaves favors the condensation of the mists, which falls as droplets at the foot of each plant, the phenomenon known as "horizontal rain".

Figure 1. Tabaibal-cardonal, near Tamaimo

Above 1,600 meters there are fewer clouds and another drying trend exists. There are only two peaks in the Canaries that are higher than the limit at which forests can form, about 2,300 meters (Fig. 4). El Teide on Tenerife, at 3,718 meters (12,198 feet), is higher than any peak in peninsular Spain. Average annual temperatures at sea level (Santa Cruz de Tenerife) range from minimum 18C to maximum 24C (AEMET, ibid). On El Teide the top 1400 meters is hot and dry from May to September and can be freezing cold at night from October to April. Snow accumulation is common from December through February. In fact, the locals have a saying that unless there is snow up on El Teide, there can be no Christmas, but as long as anyone can remember there has always been snow on December 25th (Fig. 5). This harsh environment is home to its own unique endemic vegetation, the "high mountain coenosis". This term, popular with European ecologists is defined as "a community of organisms interconnected by mutual relations and inhabiting a certain area" (CHU ČR 2, no date).

The amazing richness and variety of the Canarian flora, while clearly the result of this combination of unique climatic factors, has also been shaped by recent volcanism. The last eruption on Tenerife was in 1909, but the 26 eruptions of the first few decades of the 18th century were far more significant. A total of 11 towns including the major port of Tenerife at the time, Garachico, were completely destroyed and most of the island was devastated. The *Drago Milenario*, thought to be the world's oldest dragon tree, narrowly escaped destruction by the Garachico lava flow. El Teide is estimated to have once been nearly 5,000 meters tall before its central cone collapsed forming the 12 by 17 kilometer Caldera de Las Cañadas, a National Park. Subsequent eruptions created the new volcanoes of El Teide and Pico Viejo in the center of the caldera and a ring of smaller volcanoes around the periphery (Fig. 6). Each of the other islands has experienced similar volcanic events which altered their physical landscapes forever.

The *Laurisilva*

Another significant botanical treasure of the Canary Islands is the subtropical paleo-forest known as the *Laurisilva*, which 20 million years ago covered the entire Mediterranean basin. As a result of cycles of glaciation together with the gradual dessication of the region over the past 10,000 years this fossil forest has retreated south and west to the few Atlantic island groups where sufficiently high moisture still exists. In the Canaries only the island of La Gomera, west of Tenerife, and isolated canyons on a few other islands preserve undisturbed examples of the surviving flora, estimated at no more than 6.7% of the total land area and only 1% of Gran Canaria (EEA/EBM, no date). It is characterized by woody evergreen plants with dark green, mostly lanceolate and coriaceous leaves. Typical species include *laurel de Canarias* or *loro* (*Laurus novocanariensis,* once known as *L.azorica*) and *barbusano* (*Appollonias barbujana*), both large trees of the family Lauraceae. Numerous vines, such as Canarian ivy (*Hedera canariensis*, Araliaceae) and *gibalbera* (*Semele androgyna*, Convallariaceae) form an interconnected and sometimes impenetrable understory, with associated mosses, ferns and lichens. Remnants of the *Laurisilva* in a degraded form can still be found scattered on north slopes throughout the *monteverde*, except on Lanzarote and Fuerteventura where it has apparently disappeared (WWF, 2001).

The Subtropical Wet Side

The Canaries in general and Tenerife in particular are a palm tree paradise. The endemic Canary Island date palm (*Phoenix canariensis*, Arecaceae) is found widely in cultivation on all seven main islands up to 1,000 meters, but in the wild is increasingly restricted to a dwindling number of canyon bottoms. The *Guanches* in pre-Hispanic times used the leaves for roofing and basketry and the hollow trunks as beehives. The natives of la Gomera learned to extract the sap from the trunks for the manufacture of *guarapo* , which is still used as honey (Haynes & McLaughlin, 2000).

Figure 2. Mist forming above 800 m Barrano de Guinguada

Figure 3. *Pinus canariensis* crown forest El Teide

Figure 4. Upper limits of pine forest, El Portilla visitor center, TN

Figure 5. Snow-capped El Teide on Christmas Day 2007.

Figure 6. Pico Viejo in the center of the caldera and a ring of smaller volcanos around the periphery.

Date palms (*Phoenix dactylifera*), Mediterranean fan palms (*Chaemerops humilis*) and dozens of other introduced palm species thrive. The many outstanding palm gardens include Loro Parque in Puerto de la Cruz, Tenerife. Famous for having the biggest penguinarium and largest collection of parrots on earth (4,000 birds of over 350 species and subspecies), its living collection of 8,000 palm trees includes a grove of 750 Kentia palms (*Howiea forsteriana*) from Lord Howe Island east of Australia (Loro Parque, 2007). Another interesting tropical garden under glass, the Mariposario del Drago in Icod de los Vinos, is home to the world's largest exotic collection of living butterflies (Mariposario, 2007).

El Jardin de Aclimatacion de La Orotava, also in Puerto de la Cruz, was established by King Charles III in 1788-92 to receive the palms and other tropical plants being brought back by explorers such as Captain Cook and Alexander Von Humboldt. Together with its nearby XIX century sister garden La Hijuela it holds nearly 4,000 living species and 37,000 dried specimens (JAO, 2007). Many of the original two century old plants have been preserved here, such as a magnificent Moreton Bay fig or Australian banyan (Fig. 7). Most of the islands' arable wet side land was long ago terraced with volcanic stone and planted in grape vines and other crops. Beginning in the 1870's bananas were introduced, and are now the most important economic activity after tourism. Such is the mildness of the climate and the fertility of the soil that many decorative species from the New and Old Worlds alike have escaped from cultivation and become widespread. The problem of invasiveness has long been recognized as an ecological catastrophe particularly on Gran Canaria. The problem is less acute on Tenerife and the smaller islands (EUROPARC, 2002).

Dragons and Troglodytes

The Jardín Canario, established in 1952-59 in a canyon alongside Tafiro Alto, Gran Canarias holds one of the world's most important collections of endemic Canarian plants (Jardín Botanico, 2008). The Swedish botanist Eric

Figure 7. 200 year old Moreton Bay Fig, El Botanico, TN

Ragnor Sventenius lived here for 20 years while supervising its development, which at 27 hectares makes it the largest botanical garden in Spain. After a tragic auto accident in 1973 he was buried at the foot of the waterfall that bears his name, surrounded by the reproduction of the *Laurisilva* that he planted in 1964. Besides the endemic Macaronesian plantings, there are lovely taxonomic gardens (Fig. 8 and 9) as well as artificial forests of endemic Canary Island pine and dragon tree (*Dracaena draco*, Asparagaceae).

I was surprised to learn that the natural habit of the dragon is always solitary. Venerable individuals occur on several of the islands, either in the wild or planted as street trees, with the largest individuals reportedly occuring on Tenerife. The largest dragon tree on Gran Canaria, located on a cliff on a private finca in the Barranco Alonso near Arucas, is historically dated at 500+ years. Although I photographed other giants during my explorations, I made a special trip to the Parque del Drago in Icod de los Vinos, Tenerife to locate the reputedly oldest specimen in the world, the *Drago Milenario*. It is 17 meters tall, weighs 80 tons and has almost 300 branches. The actual age is controversial, as it existed when the town was founded in 1496. Popular estimates have ranged from 1,000 to nearly 2,000 years old, although 800 is probably more realistic (Drago Milenario, 2004)(Fig. 10 and 11).

Figures 8 and 9. Endemic succulents Jardín Canarias, GC

Figure 10. Plaza de los Nenufares, Jardin Canarias, GC

Figure 11. Dragons and Canary Island pines, Jardin Carnarias, GC

Figures 10 & 11. Drago Milenario, Icod de los Vinos, TN

The Parque del Drago, located adjacent to the main plaza of the town, is an ethnobotanist's dream. Paths wandering through well-labeled interpretive gardens lead the visitor to a small, hidden canyon below. Within is a carefully reconstructed *Guanche* village complete with life-sized models of the inhabitants engaged in everyday activities. The highlight is an authentic *Guanche* cave containing a spring and multiple rooms. Whether hunters and gatherers, pastoral herders, or settled agriculturists, the use of metal was unknown. Their material culture was limited to stone, clay, animal skins and wood. The larger islands had the most elaborate societies, with a hereditary monarch (*guanarteme* on Gran Canaria, *mencey* on Tenerife) and nobility, priests, a council of elders and a rigid caste system. The smaller islands had one or more tribal chiefs, each with a carefully delineated territory. They mummified their dead and reverently kept them in special caves (Wendt, 1962).

In 1873 a farmer digging in his field at Galdar, the ancient capital of Gran Canaria, accidentally discovered what could have been the center of the *Guanche* universe. La Cueva Pintada is an artificial cave complex preserving the best known examples of *Guanche* geometrical cave painting. It was probably concealed prior to the final Spanish victory, and contains unmistakable evidence that important religious rituals were conducted inside. Closed for years for excavation and data recovery, the site has recently been opened to the public housed in an impressive modern building (Cueva Pintada, 2007). (Unfortunately no photography is allowed.) A few meters away in the plaza of modern Galdar, a stone statue preserves the memory of the last *guanarteme*, Tenorio Semidan, who was baptized and made peace with the Spanish (Fig. 12).

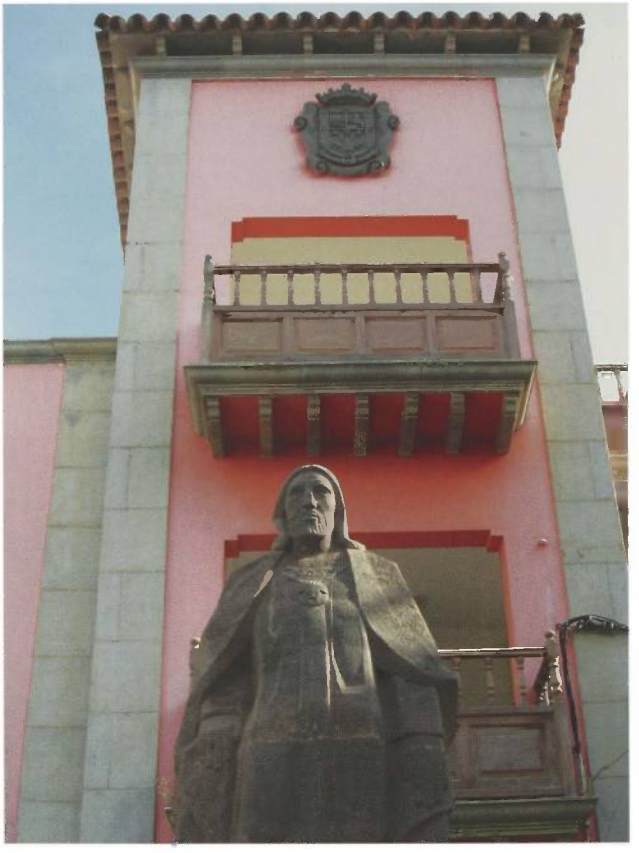
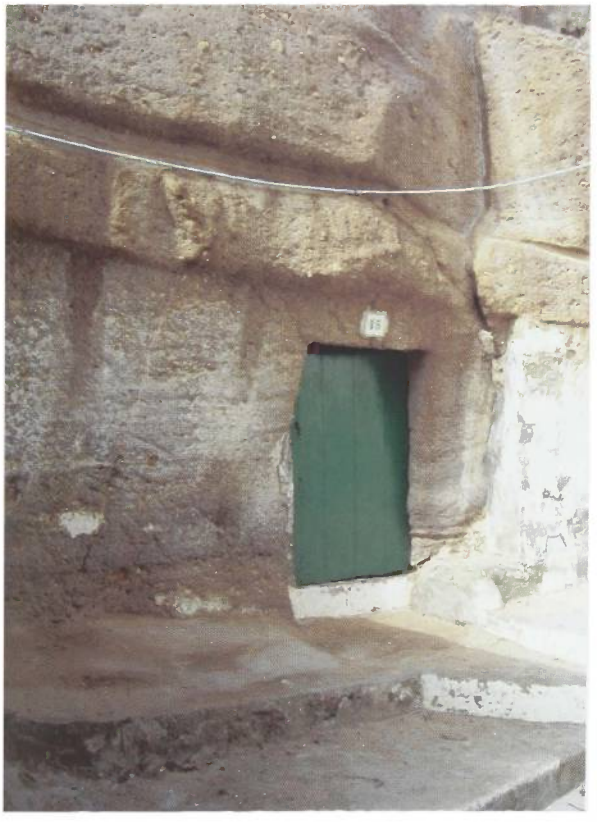


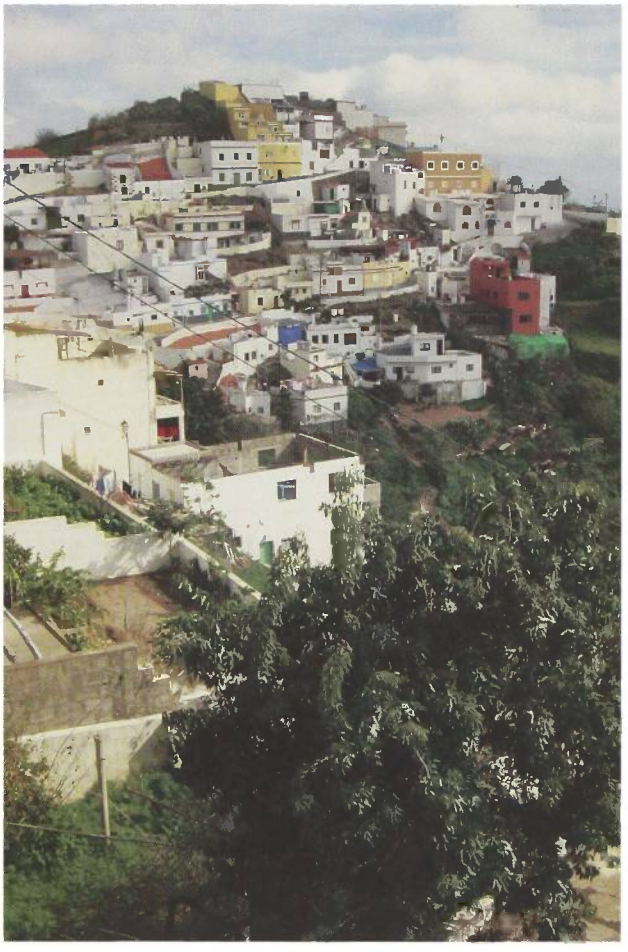
Figure 12. Tenoria Semidan

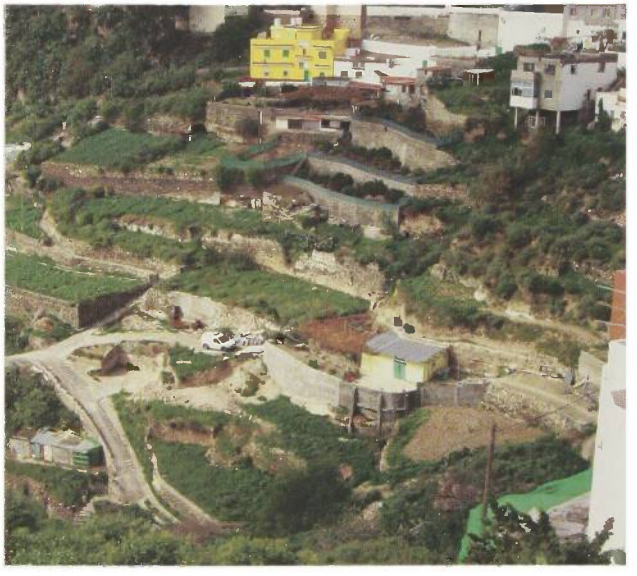
Most *Guanches* were troglodytes, either living in existing lava tubes or excavating and enlarging their own caves in soft rock. Over the centuries these have been improved and added onto and are found throughout the islands. Some of the most famous are the hundreds in the troglodyte barrio of La Atalaya de Santa Brigida, Gran Canaria (Fig. 13 - 19). This is one of the few places in Europe where the tenuous thread of direct transmission of an ancient technology can still be appreciated.

Before the invention of the potter's wheel, pottery was made by hand usually by women where high quality clay



Figures 13-16. The troglodyte barrio of La Atalaya de Santa Brigida, Gran Canaria.





Figures 17, 18, 19. La Atayla de Santa Brigada, Gran Canaria

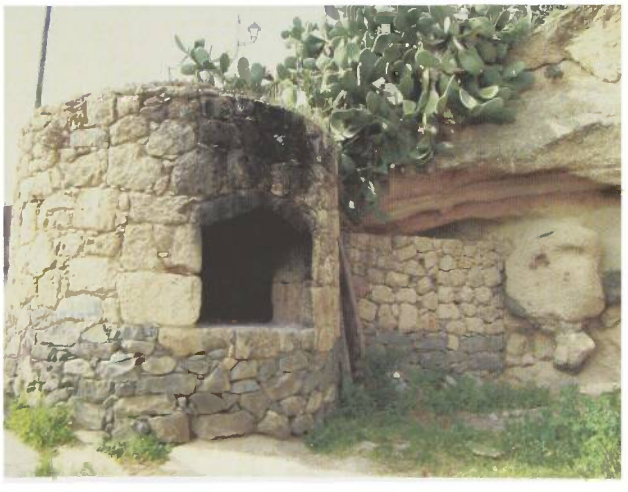


Figure 20. Original wood fired stone kiln, La Atalaya, GC

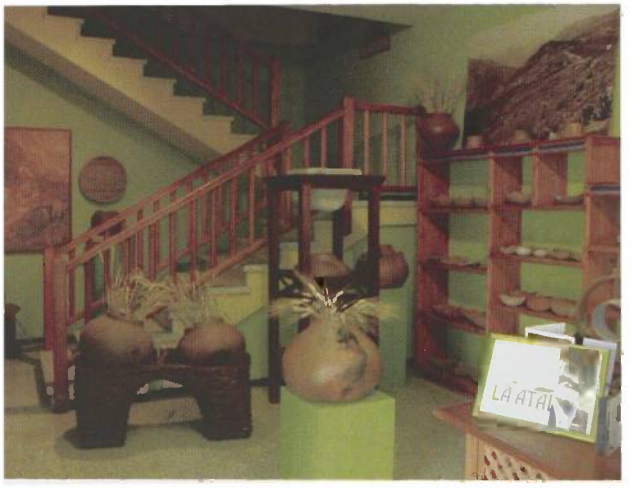


Figure 21. Centro Locero,La Atalaya,GC

deposits could be found. In 1907 the remarkable Francisco Rodriguez Santana ("Panchito") was born. He learned the craft from his mother and grandmother, and in turn passed his skills on to his daughter Antonia ("La Rubia") and a small group of apprentices. Upon the death of first one and then the other an association was formed to perpetuate the tradition. Panchito's cave workshop and original wood-fired stone kiln (Fig. 20) are still there. The three young artisans at the Centro Locero de La Atalaya have built a replica kiln, and continue to produce the same sturdy vessels using the ancient methods (Centro Locero, 2008)(Fig. 21).

Coastal and Arid Communities of Gran Canarias

As seen from the air on approach to the airport on Gran Canaria, the verdant city of Las Palmas contrasts starkly with the adjacent Isleta Peninsula at the island's northern tip. Formed by the most recent volcanic eruption, it is set aside as the Paraje Natural La Isleta. A few hours later I was walking north anticipating my first close look at the pristine native flora. I was shocked at encountering instead familiar old friends. The rugged volcanic slopes are covered almost in their entirety by prickly pears, in this case a pure stand of the introduced Mexican species *Opuntia dillenii*, known locally as *tunera salvaje* (back cover). Overnight camping is prohibited in the reserve, but signs of centuries of human impact include enigmatic stone ruins, pieces of ceramic tile, rusty nails and old bones.

After hours of searching I discovered an apparently ancient footpath dug out along a cliff. At last in soil pockets and cracks in the rocks I found examples of natives competing for existence against the aggressive invader. *Verode* (*Kleinia neriifolia,* Fig. 22), a succulent composite at the lower limit of its arid range occurs together with salt-tolerant *acelga del mar* (*Astydamia latifolia*, Apiaceae) at the upper limit of its coastal range. *Aulaga* (*Launeaea arborescens*), (Fig. 23) a handsome composite subshrub adapted to extreme aridity, was in full bloom. The narrow strip of coastal habitat influenced by the sea spray is supposed to be dominated by the halophytic succulent *Zygophyllum fontanesii*, *Frankenia* and *Limonium*. At this location I found only native *margarza*(*Argyranthemum frutescens*, Asteraceae) (Fig. 24) growing among the rocks and naturalized South African Hottentots' fig (*Carpobrotus edulis*, Aizoaceae) on the sands.

Seeking a less disturbed environment, I traveled next to Puerto de las Nieves, a small fishing village on the island's west side. It is home to one of the geological wonders of the world, what is considered to be the largest active cliff on earth at 2,000 meters in elevation. On the long bus ride across the "roof" of Gran Canaria the extent of the prickly pear invasion became apparent. The same species of *tunera salvaje* dominates the visual landscape. As a result the habitat for key species of the *tabaibal-cardonal*, the giant succulent Euphorbias, has become increasingly restricted. The physical environment of the west side in general and

Figure 22. *Kleinia neriifolia* and *Opuntia dillenii*

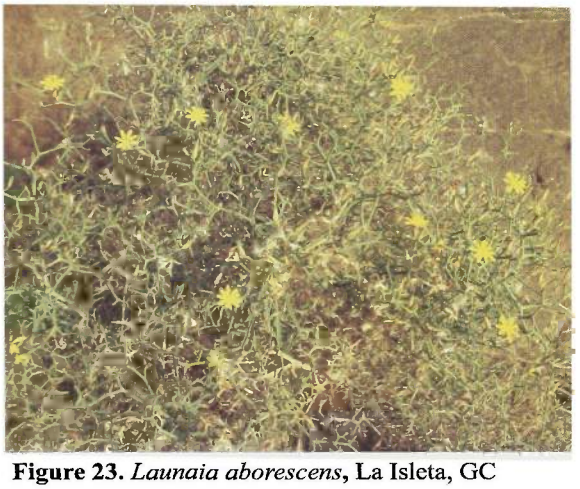


Figure 23. *Launaia aborescens*, La Isleta, GC

Puerto de Las Nieves in particular is truly breathtaking. The fabled *Dedo de Dios*, the rock formation known as the "Finger of God", was blown over by 125 kilometer per hour winds in late November 2005 during Tropical Storm Delta, one of the most powerful storms to strike within human memory. The towering cliffs which continue deep below the sea appear to be almost devoid of life except high up on their tops, which in any case appear inaccessible (Fig. 25). Again I was disappointed in finding undegraded examples of native arid communities.

Bandama Caldera

Bandama Caldera, a 574 meter cinder cone volcano south of Las Palmas, is at the interface between the upper limit of the arid flora and the lower limit of the *monteverde*. Characterized as the *bosque termoesclerófilo* ("thermophillous woodlands"), it is the natural habitat of

Figure 24. *Argyranthemum frutescens,* La Atalaya, GC

Figure 25. Towering cliffs of Puerto de Las Nieves

Figure 26. Bosque Esclerófilo, Jardin Canarias, GC

the dragon tree and Canary Island palm. Other key species include *acebuche* ("Canarian olive", *Olea europaea ssp. cerasiformis*), *almácigo* (*Pistacia atlantica*), *lentisco* (*P. lentiscus*), *guaydil* (*Convolvulus floridus*), *palo de sangre* (*Marcetella moquiniana*) and numerous leafy shrubs. Specimens of each can be found here, but this formation has practically vanished on the island, since it lies in the most favorable zone for agriculture and human settlement. Sventenius realized that the nearby Jardín Canario had potential for its reestablishment, and 35 years ago planted an excellent reproduction along the cliff below the Visitor's Center (Fig. 26).

The access road from the bus stop to the top spirals around the almost symmetrical cone, affording spectacular 360-degree views of the island as well as of the interior of the 200 meter deep by 800 meter wide crater (Fig. 27). The road cuts reveal layers of cinders ejected during the eruption, which are piled up on the west side to form the Pico de Bandama. Here at last I was delighted to encounter in the wild the familiar succulents I had grown under glass for years at the Boyce-Thompson Arboretum.

Meter-high thickets of *hierba puntera* (*Aeonium arboreum*, Crassulaceae) flourish wherever the slope stability permits (Fig. 28). *Taginaste blanco* (*Echium decaisnei*, Boraginaceae) was in full bloom, perched dramatically even on the steepest slopes (Fig. 29 and 30).

The composite genus *Sonchus* exhibits adaptive radiation with 13 species, several of which are arborescent. It is represented here by hanging gardens of *cerrajón* (*Sonchus acaulis*) and filiform-leafed *baillo* (*Sonchus leptocephalus*) (Fig. 31). Numerous miniature Crassulas such as *Umbilicus gaditanus* (Fig. 32) and *Aeonium haworthii* grow in rock cracks or sheltered volcanic cliff faces together with the orchid *Habenaria tridactyloides* (Fig. 33).

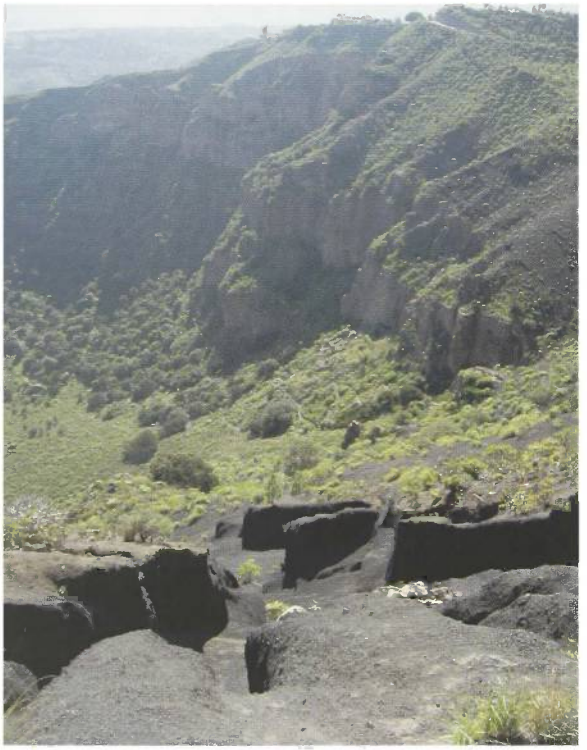


Figure 27. Bando Caldera, GC

Figure 28. *Aeonium & Echium,* Bandama Caldera, GC

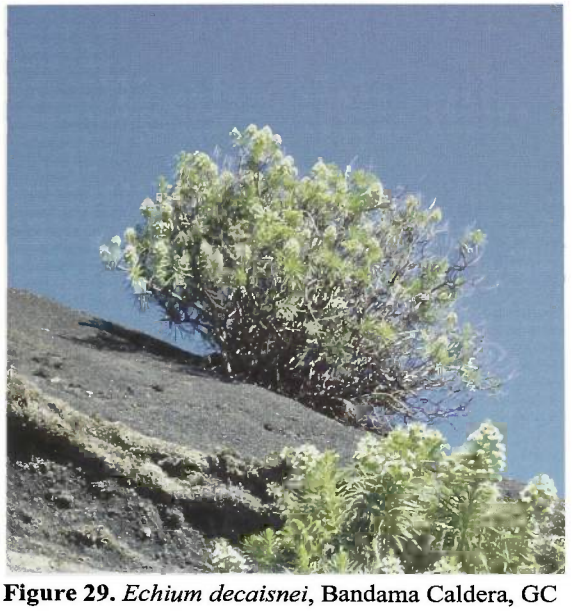


Figure 29. *Echium decaisnei*, Bandama Caldera, GC

Figure 30. *Echium decaisnei* in full bloom

Figure 31. Hanging gardens of *Sonchus acaulis, S. leptocephalus* and *Pistacia lentiscus,* Bandama Caldera, GC

Figure 32. *Umbilicus gaditanus*, Bandama Caldera, GC

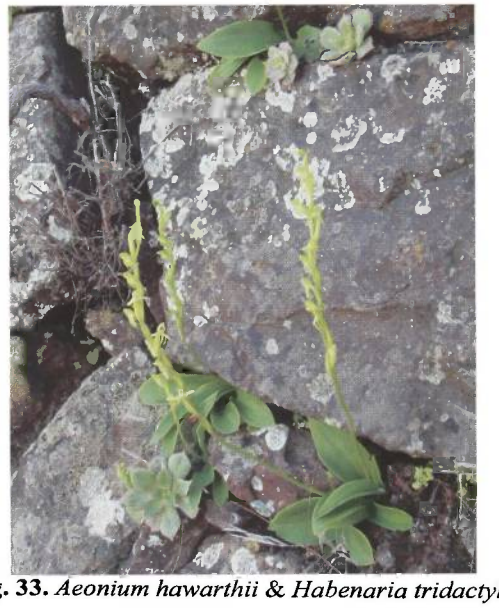


Fig. 33. *Aeonium hawarthii & Habenaria tridactyloides*

Bandama Caldera, although also a protected natural area, is another excellent location to observe the spread of invasive species. These include various prickly pears, South African jade plant and gazania, Argentine tree tobacco, bougainvillea, geranium, and many others. By far the most prominent invasive is the century plant (*Agave americana*), which exists in the thousands (back cover). The reverse phenomenon of the colonization by natives of the urban environment is also common. *Aeonium urbicum* (named for its affinity for cities and towns) thrives along with *Echium* and *Sonchus* atop an abandoned storehouse near the bus stop.

Figure 34. *Euphorbia lamarckii,* "taibaba anarga', Puerto Santiago, TN

Figure 35. *Euphorbia canariensis*, "cardon"

Arid Environment of Tenerife

The difference in the integrity of the natural arid plant communities of Tenerife compared to Gran Canaria is immediately apparent. I repeated my bus trip across the verdant north part of the island to the drier west side at Puerto Santiago, which is overshadowed by the towering Acantilado de los Gigantes, the "Cliff of the Giants". As on Gran Canaria prickly pears (in this case, *Opuntia maxima)* are widespread, but occur at much lower overall densities. Puerto Santiago is a well known tourist resort, but particular care has apparently been taken to preserve and incorporate the native vegetation.

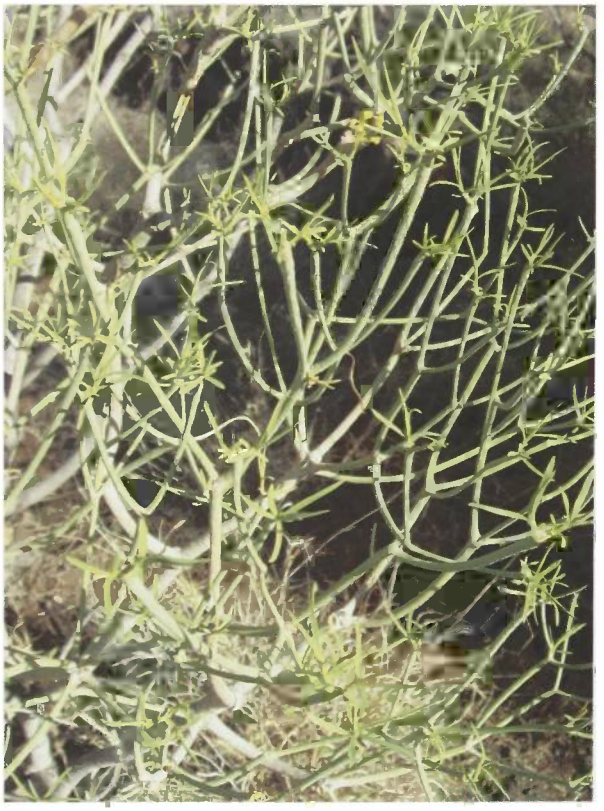


Figure 36. *Euphorbia lamarckii* blooms

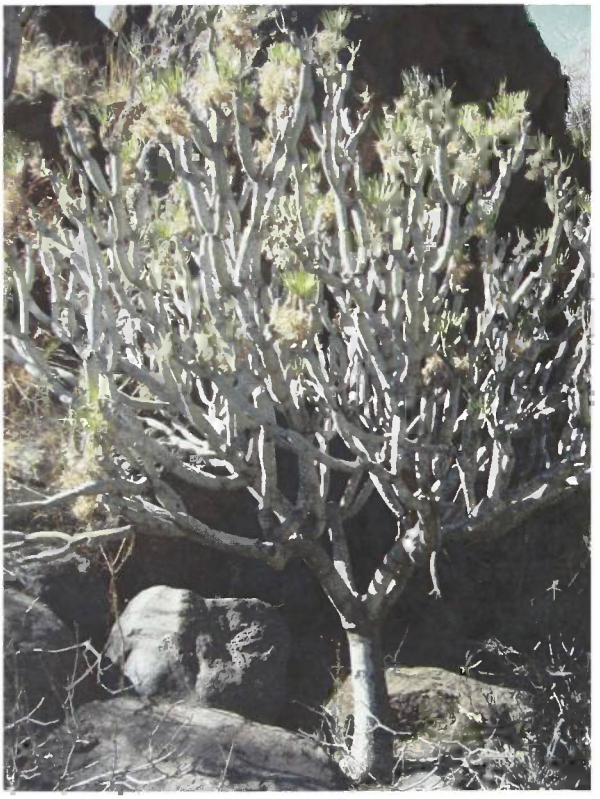


Figure 37. Large *Kleinia neriifolia,* Puerto Santiago, TN

After a short climb into the nearby hills I was at last in the undisturbed *tabaibal-cardonal.* This characteristic plant community of the arid lower slopes takes its name from the giant euphorbias *tabaiba amarga* (*Euphorbia lamarckii,* Fig. 34) and *cardon* (*E. canariensis,* Fig. 35). The first, previously known as *Euphorbia obtusifolia,* is also commonly known as *higuerilla* ("little fig") in reference to its distinctive fruits. At this time of year it was just beginning to bloom (Fig. 36). Even here on the dry hillsides volcanic stone terraces of indeterminate age are evident. Quite old specimens of *Kleinia neriifolia* are common, and their persistent skeletons litter the hillsides (Fig. 37). Their stubby trunks and compact rounded forms show adaptive convergence with *Euphorbia lamarckii* and its counterpart *tabaiba dulce* (*Euphorbia balsamifera*).

Important shrubby composites include *madarna* (*Allagopappus dichotomus,* Fig. 38), *salado* or *dama en mayo* (*Schizogyne sericea,* Fig. 39) and *magarza gracil* (*Argyranthemum gracile,* Fig. 40). *Matorrisco tinerfeno* (*Lavandula bruchii*, Lamiaceae) has medicinal uses and was also beginning to bloom (Fig. 41). *Balo* (*Plocama pendula*, Rubiaceae) is an attractive common tree with a pendulous habit and irritating sap (Fig. 42). *Ratonera* (*Forsskaolea angustifolia*, Urticaceae) and *Atriplex halimus*, Chenopodiaceae were also common shrubs at this location. On returning to the port, I discovered a *cardoncillo* (*Ceropegia dichotoma*, Asclepiadaceae), a salt-tolerant plant of the coastal zone, blooming at the base of a cultivated cactus (Fig. 43).

High Mountain Coenosis

The Parque Nacional de Las Cañadas del Teide can only be reached by narrow switchback roads with hairpin turns. As most visitors prefer to rent cars to make the hour-long ascent, there is only one bus per day from Puerto de la Cruz. It leaves at 9:00 AM sharp, stops only at the El Portillo Visitor's Center, the Teleférico and the Parador Nacional, and returns at 4:00 PM. The ascent through the *monteverde* and crown forest is breathtaking. Thousands of *Aeonium tabulaeforme* grow on the road cuts and cliffs along the way. Up on top at El Portillo the road levels out, and the bus driver stops for a break. My traveling companions, Quechua Indians from Bolivia, assured me that the landscape was very much like their home in Cochabamba.

From the parking lot at the Teleférico there are two options to reach the top of the Teide volcano, either climb or wait in the long line and pay 24 Euros to take the cable lift. The actual summit, Pico Blanco, because of its ecological sensitivity is restricted to no more than 200 people per day. The special permit can only be obtained at the park offices in Santa Cruz, by mail or on line, in which case you are informed in advance of the day you will be allowed to ascend. Having only six hours to spend and anxious to get to botanizing, I skipped the peak, home to the *violeta del Teide* (*Viola cheiranthifolia*, Violaceae). Described by Alexander Von Humboldt, it is the only plant which grows on the highest part of the peak, so is the highest flowering plant in Spain. I set off on one of many trails that cross the vast caldera, which with its alien treeless landscape and cloudless cobalt blue sky was like exploring another planet.

Besides the challenges of heat, cold and drought, the native plants within the caldera have also had to adapt to volcanism. The fantastically colored new lava is infertile, and it takes many years for soils to form from it. In the Caldera de Las Cañadas the first plant to colonize new lava is a crucifer, *hierba pajonera* ("flixweed", *Descurainia bourgeauana,* Fig. 44). The next is a new composite species, *Argyranthemum teneriffae*, which has appeared since the latest eruption and seems to grow only on the newest flows.

Growing mainly on the steepest slopes, the signature plant of the caldera, *Echium wildpretii* ("bugloss", Boraginaceae), known variously as *taginaste rojo*, *orgullo de Tenerife* ("pride of Tenerife") and *taginaste del Teide*, has a most startling form. After two years during the spring the bloom stalk rises to as many as three meters from the basal rosette of leaves, with hundreds of tightly-packed red blooms. It is also a honey-producing plant. Unfortunately during my winter visit only the dead stalks from the previous year were in evidence (Fig. 45 and 46).

The dominant shrubs and subshrubs are leguminous, with reduced leaves, tiny white hairs, a cushion form and deep roots as adaptations to the harsh conditions. *Retama del pico* or *retama del Teide* ("Teide broom", *Spartocytisus supranubius*) is practically leafless, grows to 2-4 meters tall and sprawls to many meters in diameter (Fig. 47). It often forms extensive pure stands (Fig. 48), and serves as a nurse plant for other species. It is one of the few plants on Teide that grows large enough to produce significant amounts of firewood, and the fragrant white to pinkish blooms are a good source of honey. Beehives are seasonally transported up the mountain, with signs warning hikers of their proximity. *Codeso de cumbre* ("sticky broom", *Adenocarpus viscosus* var. *viscosus*) is another striking common legume with small hairy leaves and yellow blooms (Fig. 49).

Fifty-eight plants found in the Parque Nacional are Canarian or Tenerifean endemics, and 12 species occur nowhere else but here (Gobierno de España, 2004). Other key plants of the caldera take some work to find, unless the visit is in the spring when the bright colors of the flowers guide the uninitiated. These include purple or red-flowered *hierba de cumbre* (*Scrophularia glabrata,* Scrophulariaceae), violet and white-flowered *ahelí* ("Canary wall flower", *Erysimum scoparium,* Brassicaceae), pink-flowered "shrubby scabious", *Pterocephalus lasiospermus* (Dipsacaceae) and light blue to purplish-flowered *neuta* or *hierba gatera* ("Teide cat mint", *Nepeta teydea,* Lamiaceae). Happily, I never encountered the slightest indication of invasiveness within the Caldera de Las Cañadas. The environment must be too hostile for any exotic plant to survive.

Figure 38. *Allagopappus dichotomus,* 'madarna'

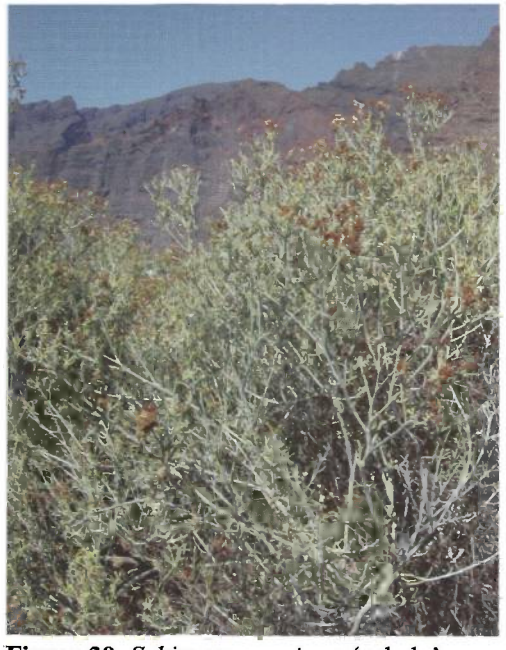


Figure 39. *Schizogyne sericea,* 'salado'

Figure 40. *Argyanthemum gracile,* 'margarza gracil'

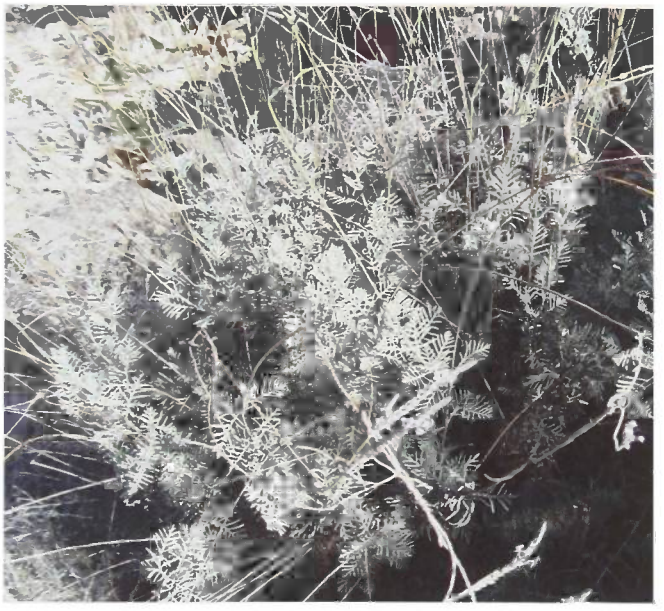


Figure 41. *Lavandula bruchii,* 'matorrisco tinerano'

Figure 42. *Plocama pendula,* 'balo', *E. canariensis*

Figure 43. *Ceropegia dichotoma,* 'cardoncillo'

Figure 44. *Descurainia bourgeanana,* 'hierba pajonera'

Figure 47. Pure stand of *Spartocytisus supranubius*

Figure 45. *Echium wildpretii,* 'taginaste rojo'

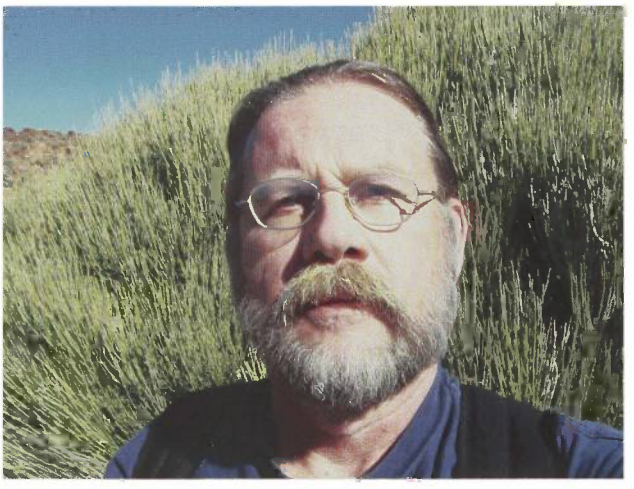


Figure 48. The author and *Spartocytisus supranubius*

Figure 46. *Echium wildpretii*

Figure 49. *Adenocarpus viscosus,* 'codeso de cumbre'

Fire and Climate Change

The wildfires that burned 15,000 hectares on Tenerife and 20,000 hectares on Gran Canaria last summer destroyed about one-quarter and one-third respectively of the total forested area (about 86,000 acres). Because of its thick bark, abundant sap and high branching habit the Canary Island pine is to a certain extent fire-adapted. The *brezo* ("tree heath", *Erica arborea*) and some other tree species are part of the Mediterranean flora and thus fire-adapted, but most of the understory elements are not. Preliminary surveys revealed that out of a total of 120 species listed as endangered (Jardín Botánico,2008), 30 species were permanently harmed, with about 10-15 of those expected to vanish as a result (Foresta, 2007). Although started intentionally by man, the extent of the blazes and degree of destruction is considered to be due to record high temperatures and winds coupled with low humidity, two more in a series of weather-related calamities blamed on global warming to have hit Europe in 2007 (Gobierno de España, 2007).

Fires in the Mediterranean basin rarely occur as a result of natural causes but are usually intentionally or negligently set by man. Over thousands of years, the Mediterranean flora has adapted to a periodic fire regime and to some extent depends on it. According to Professor Goldammer of the Global Fire Monitoring Center in Freiburg, Denmark the number of forest and scrub fires in southern Europe has increased significantly since the 1970's (GFMC, 2001). The Intergovernmental Panel on Climate Change has predicted an increase in the frequency of extreme weather conditions, average wind speeds and a decline in rainfall in some regions (IPCC, 2007). Spain, Portugal and the Eastern Mediterranean are clearly affected. Spain in early 2008 experienced its driest trimester in 60 years, and reservoirs in Catalunya stood at only 27% full (AEMET, 2008).

I did not revisit the burned-over areas I first saw on Gran Canaria last year, but I examined the burned area in western Tenerife near Santiago del Teide. This was a clearly a crown fire which resulted in total destruction. Five months after the fact, and in spite of recent rains, there was no sign of any survival or recovery. It is now accepted that fire is considered to be an ecological catastrophe that should be prevented in Tenerife. (Arévalo, et al., 2001)

Islands are recognized as the "canaries" of climate change. Because of their isolation, species have no way to escape, and once lost, no natural way to reestablish themselves. There is no doubt that historic human impacts, including grazing, clearing land for agriculture and settlement, timber harvest, road building and invasiveness, have reduced the viability of native ecosystems. To date, the establishment of seed and germplasm banks, *in-situ* preservation efforts and botanical collections have been the response of concerned scientists to these challenges. The prospect of desertification due to climate change, the specter that now looms over these islands, is one that in the long term may be unavoidable.

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