

economic thresholds. Over 60% of bird species from the southeastern Atlantic Forest are extinct, critically endangered, or vulnerable (Ribon et al. 2003), while in the northeast over a third of tree species are currently threatened with extinction. Failure to restore the Atlantic Forest will likely lead to a wave of extinctions in the future (Brooks & Balmford 1996), potentially reducing biodiversity by more than 50% if we extrapolate from studies of island biogeography (MacArthur & Wilson 2001). Compliance with the Forest Act would increase the connectivity of existing forest fragments by restoring riparian corridors and other critical habitat (Metzger 2010). However, it would also drive farmers into poverty. A similar dynamic is currently playing out on a global level, where agriculture is the leading threat to global ecosystems (Millennium Ecosystem Assessment 2005; Rockström et al. 2009), but 1 billion people are currently malnourished, and the failure of food production to keep pace with growing populations threatens famine or worse (FAO 2011).

The costs to society of inadequate food production and of massive biodiversity loss are both unacceptably high. Society's challenge is to find land uses that serve as vital corridors between remnant habitats without sacrificing food production. Our research in Santa Catarina suggests that agroecological practices, such as agroforestry and silvopastoral systems, are promising solutions to one of society's most serious challenges.

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The Coal Canyon Story

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At the juncture of 4 of Southern California's most rapidly growing counties lies a transverse hillside system known as the Puente-Chino Hills. Local lore holds that treasure still lies buried in these hills, but the real treasure lies above ground along the streams and in the oak and walnut woodlands.

These hills are an extension of the Santa Ana Mountains, separated from them by the Santa Ana River and the Whittier and Chino earthquake faults in the Elsinore Fault Zone. The hills are bounded by the 605 freeway on the west in Whittier, the 60 freeway to the north in southeastern Los Angeles County, the 71 freeway on the east in the city of Chino Hills in San Bernardino County, and the 91 freeway on the south in Riverside and Orange Counties. The hills are virtually an island in a sea of urbanization.

Oil was discovered here in 1880, leading to an array of oil companies purchasing large parcels of land hoping to exploit the resource. Many of the oil fields are now depleted, but a century's worth of extraction kept housing developments at bay (Keating 2006).

Despite the real estate boom and the now 18 million inhabitants, the hills remained relatively undeveloped, thereby providing an opportunity for area residents to organize to protect them. Efforts began in the mid 1970s to establish Chino Hills State Park (CHSP) on the eastern side of the hills. Today CHSP protects over 5,706 ha of oak and

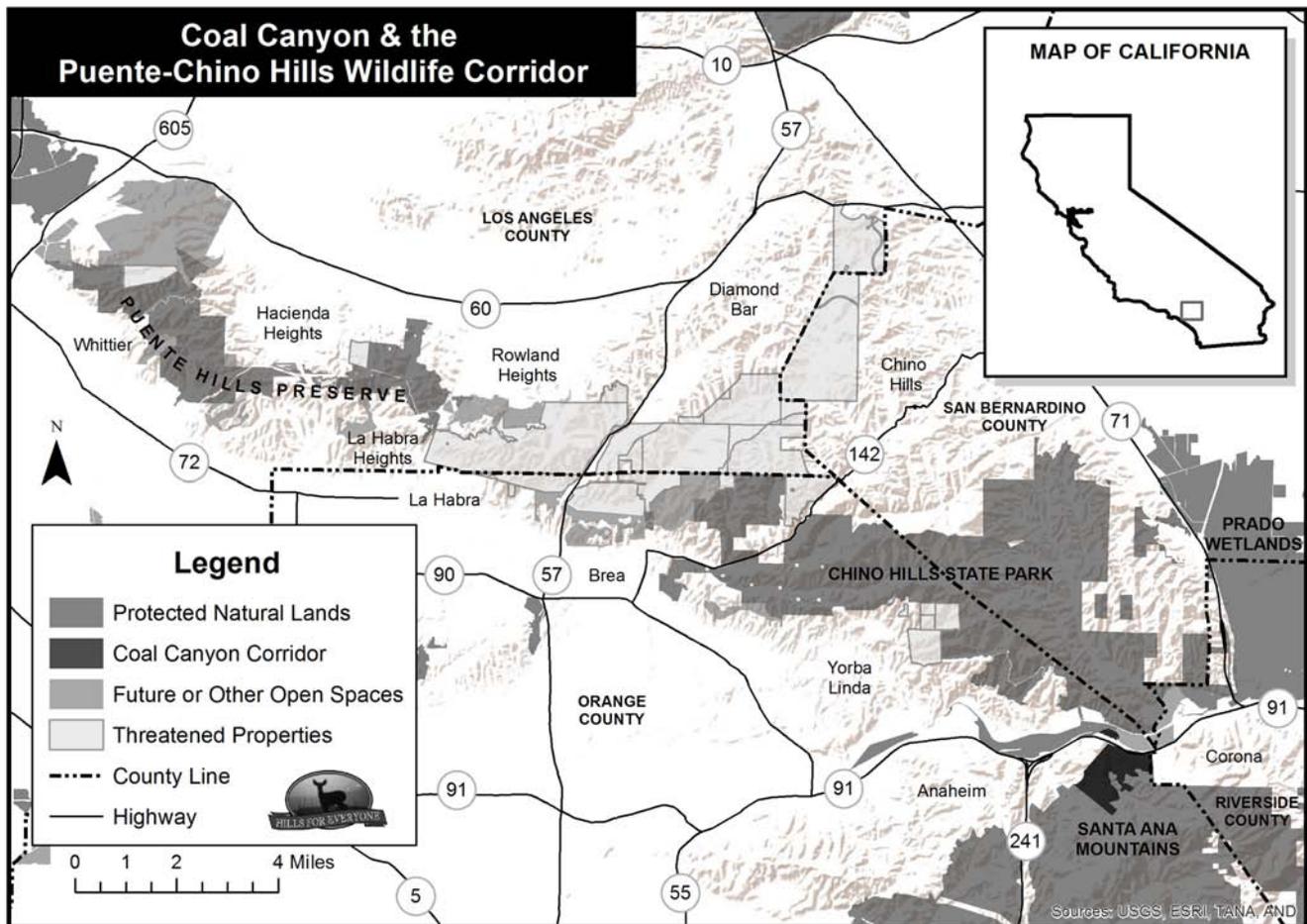


Figure 1. The Coal Canyon Corridor connects Chino Hills State Park to the southern Santa Ana Mountains in southern California. The corridor was preserved through partnerships formed between conservation agencies, state agencies, and a private landowner.

walnut woodlands, grasslands, chaparral, and coastal sage scrub. As part of the California Floristic province, the area is considered a “Hot Spot of Biodiversity” (Conservation International 2012).

To the west, residents in Whittier began organizing in the early 1980s, drawing on a map what they planned to protect. To date they have secured nearly 1,620 ha. In 1994, as public understanding of the concepts of conservation biology grew, conservationists joined forces across the hills and across political boundaries to work together to connect the remaining wildlands. Four cities, 3 state resource agencies, and public members formed the Wildlife Corridor Conservation Authority.

The Authority’s first task was to identify the impediments to connectivity. A landmark mountain lion (*Puma concolor*) study in the early 1990s provided indisputable evidence that only one connection, Coal Canyon, remained linking the hills to the larger natural lands of the Cleveland National Forest in the Santa Ana Mountains (Beier et al. 1993). Decades earlier, a freeway underpass with on and off ramps was built at Coal Canyon, but the land on either side remained undeveloped. They were exit ramps to nowhere. Cougars were using 2 side-by-side 8 × 8-ft

culverts that were each approximately 850 ft long; however, these culverts did not work for the suite of other wildlife that needed to be able to roam (Noss et al. 1998).

The cost of extending utilities to this area helped delay development. The 13 ha on the north side, in the city of Yorba Linda, was zoned commercial. The City longed for sales tax revenue from an outlet mall. The 264-ha parcel on the south side in Anaheim was already entitled for over 1,550 housing units, 3.2 ha of retail, an elementary school, and open space.

Across the hills, attention by all interested government entities and activists became focused on saving Coal Canyon. From the beginning, the effort to establish CHSP had enjoyed strong support across county and party lines. Democrats and Republicans in both the Assembly and Senate across the hills continued to work together to affirm state interest in protecting Coal Canyon with bipartisan member requests for funding.

In 1997, the effort to protect Coal Canyon began in earnest. At the urging of a CHSP Resource Ecologist, the book *Song of the Dodo* (Quammen 1997) circulated through the coalition of activists and government officials. The Chief of Resource Protection for the California

Department of Parks and Recreation (DPR) was intrigued by the importance of connectivity to the whole state park system and hired respected biologists as consultants to ask their expert opinion on the functionality and importance of Coal Canyon. The consultants visited Coal Canyon and CHSP in late 1997 and verified its significance (Noss et al. 1998), providing scientific validation for what could become an expensive but groundbreaking pair of acquisitions. At stake was the long-term value of the investment of tax dollars (upwards of \$150 million) already made to protect this ecosystem. Noss and colleagues' (1998) study predicted that over time, without Coal Canyon providing a connection to the greater Santa Ana Mountains, the "island" of the Puente-Chino Hills would experience a trophic cascade of extinctions.

On the political front, local activists worked with their legislators to identify funds for Coal Canyon. Working cooperatively, Assembly and Senate Republicans and Democrats designated \$1 million in funding in 1997 for an initial show of state interest in acquiring Coal Canyon. This funding coup was covered by 6 newspapers and foreshadowed the ongoing press interest and contribution of the press to the overall effort. Four newspapers, including the Los Angeles Times, wrote 8 supportive editorials over subsequent years (Los Angeles Times 1997, 1998, Press Enterprise 1998, Whittier Daily News 1998).

Within a month of this initial funding, the larger southern parcel changed hands. The new owner hoped to cash in on the development rights the previous owner had secured but had been unable to exploit. Though this sale escalated the price of the property, the change of ownership proved crucial.

The following year the state came up with \$6 million in transportation funds. That continued interest from a non-resource agency was enough to convince the new owner that there was real interest in state acquisition of his newly acquired property. He hired his own team of consultants to determine whether this was just another environmental battle or if there was a legitimate region-wide interest at stake. The group reviewed the literature and letters that the DPR had accumulated and decided that the threat of fragmentation and extinctions was significant. As a result, serious negotiations over the sale price began.

With the landowner's team working in concert with environmentalists and state agencies, they eventually secured \$50 million in funding for the 264 ha with a nearly even contribution of public and private funds. Though costly, it was one significant step toward protection of the governmental investment in open space in the Puente-Chino Hills. The largest contributor was the California Department of Transportation (Caltrans), who recognized that protected open space at this highly congested section of the Riverside Freeway was much preferred to the approved addition of over 15,000 more vehicle trips a day at the Coal Canyon interchange (Berthelsen 2003).

A huge, almost fair-like on-site celebration ensued in late 2000. The day before the official party, Native American Peoples from 2 tribes came to prepare the land with an invocation for protection, welcoming permanent safety for the wildlife by placing ceremonial staffs at each end of the freeway to mark the corridor. When the property owner spoke, he received a well-deserved and long standing ovation. But the uninvited guests stole the show—2 golden eagles (*Aquila chrysaetos*) soared above the canyon verifying the wildness that still reigns in this region.

Negotiations were already underway for the smaller property north of the freeway. Eight months later protection of this parcel, too, was celebrated. The price tag for this undeveloped commercial property came in at \$13.5 million. This time most of the funds came from Park Bond Acts with \$2.5 million in private donations.

Over the next several years, Caltrans began the process of decommissioning the Coal Canyon underpass and removing it from their freeway signage (Berthelsen 2003). The only compromise that was required was the result of a demand by the California Highway Patrol, who wanted a one lane turn around access so that patrol cars heading east could use the underpass to head west in case of emergency. Thankfully, days may be numbered for this convenience. Removal of the asphalt in the underpass was celebrated in 2004.

Challenges remain. Though both sides of the underpass are now owned by DPR, the underpass itself is owned by Caltrans. The Riverside Freeway has been widened by 1 lane in each direction with 2 more lanes in each direction nearing approval. Not only does this lengthen the tenuous passageway for wildlife but it also adds more freeway noise. Caltrans has not restored the underpass with native vegetation as required, fearing they will be held accountable for loss of habitat when the new lanes are added. Frequent fires on both sides of the freeway have diminished the quality of the habitat. Still, negotiations to remedy these challenges are underway. Activists and DPR personnel remain committed to the fulfillment of the goal to maintain ecological health through connectivity.

The purchase of Coal Canyon by DPR marked the first time in California history that parkland was purchased for its connectivity value and the first time Caltrans decommissioned a freeway underpass for wildlife. DPR realigned its acquisition priorities to connect to other wildlands (Rick Rayburn, Chief, Resource Protection, DPR, personal communication). Caltrans instituted an ongoing state-wide study of other significant corridors, a study funded by SAFE-TEA LU—the 2005 federal transportation bill (California Department of Fish and Game 2005).

Engaged citizens, dedicated and informed government staff, and elected decision makers who were willing to listen to new information all came together to protect these lands. The role of the press was instrumental not only in the editorials, but also in the in-depth and widespread

coverage of the step-by-step progress. The story of Coal Canyon is the story of how government in a democracy is supposed to work.

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Strategic Acquisition and Management of Small Parcels of Private Lands in Key Areas to Address Habitat Fragmentation at the Scale of the Yellowstone to Yukon Region

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Large landscape conservation designed to ensure the survival of all native species on an increasingly human-dominated planet requires us to think at multiple scales and across multiple jurisdictions (Locke 2012). In the Yellowstone to Yukon region in the northern Rocky Mountains of western North America, the full complement of native species is found across the landscape but is not always evenly distributed. Grizzly bears (*Ursus arctos*) have been identified as a surrogate for the conservation of many other species because they are wide-ranging habitat generalists and are very vulnerable to some human disturbances, including housing developments (Frankel and Soulé 1981, Craighead et al. 1995, Meffe and Carroll 1997, Schwartz 2010). Where they occur, managing the land for their persistence is a very useful planning tool for maintaining and restoring wildlife connectivity across a vast landscape.

The Cabinet-Purcell Mountain Corridor is part of one of the largest connectivity restoration and maintenance initiatives in the world, the Yellowstone to Yukon (Y2Y) Conservation Initiative. Launched as a concept in 1993, a community of conservationists and conservation biologists agreed that this vast region of the Rocky Mountains should be considered as a whole. Subsequently, Y2Y participants struggled to determine what that would mean in an applied sense. Initial steps included both the compilation of an atlas identifying the region's shared geology, ecology, and human history (Harvey 1998), as well as attracting philanthropic attention (Tabor 1996). The atlas included range distribution maps of various species, including grizzly bears, and a model of habitat fragmentation. This fragmentation model (Figure 1) combined with grizzly bear current range maps revealed that the bears were concentrated in intact landscapes (with exception of Central Idaho where they are absent). Notably, the model revealed a zone of heavy fragmentation just north of the Canada-U.S. border along Highway 3, which bisects the entire Y2Y region. It also revealed fragmentation in the Cabinet-Yaak area of extreme northwest Montana where grizzly bears still persist in small, increasingly isolated populations. The model showed also that Central Idaho consists of a large area of intact wilderness. However, grizzly bears have been extirpated from that area which had become isolated from habitats still supporting bear populations in Yellowstone National Park and along the Canada-U.S. border. This problem was already well known, and Central Idaho's wilderness had already been identified by conservationists and grizzly bear experts as being capable of supporting a grizzly bear population (Boyce and Waller 2003).

The idea of focusing on grizzly bears was not new. The species had already been studied extensively in some parts of the Y2Y region. Indeed awareness that the many isolated