

Geography, culture history and sustainable development of an oasisana-ranchero community in the southern Sierra de la Giganta range of Baja California Sur, Mexico

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Abstract

Sierra de la Giganta mountain oases are unique ecosystems containing cultural and natural resources of intrinsic and economic importance to many stakeholders. Over the last 10 years, national and international organizations have called for the protection and sustainable use of mountain-oasis ecosystems and the species they harbor. Much of the conservation biology literature implicates rancheros as agents of oasis ecosystem decline; however, little empirical research confirms these propositions for most watersheds in the Giganta mountain range. We summarize key geo-physiographic, historic, demographic and natural resource management strategies implemented by an oasisana ranchero community from the Arroyo La Presa watershed. Historic data suggest the current population exists at levels much lower than prehistoric and historic populations. Demographic data indicates the population is either experiencing high rates of youth emigration, low fertility or both. A primary threat to oasis ecosystem functioning appears to be external pressures associated with *ejido* land sale to foreign investors. Although different stakeholders may differently frame resource management success, we believe opportunities exist for promoting culturally sensitive and environmentally sustainable growth.

Introduction

The Sierra de la Giganta (hereafter referred to as Giganta) is the longest mountain range in Baja California Sur, spanning some 150 km along its northwest-southeast axis (León and Domínguez 2006). The range is a unique subset of the Sonoran Desert biogeographic region (León and Domínguez 2006) and is part of the central gulf phytogeographic province (Reimann and Ezcurra 2005, 2007). It is considered a dry, hot desert, with the majority of rainfall (range 100-300 mm per year) occurring in summer months (León et al. 2008). The mountain range exists at the intersection of two major climatic regimes: the subtropical monsoonal rainfall regime and the winter cyclonic rainfall regime (León et al. 2008). In years where either system is weak, the Giganta receives little to no rainfall. Although this mountain has relatively low elevations (the highest peak reaches 1,600 m), minimal rainfall coupled with the narrow width of the peninsula makes few areas suitable for large hydrologic depressions (León and Domínguez 2006).

Despite this, the Giganta contains a variety of riparian habitats. Aerial photography

suggests the Giganta contains 54 oases, all of which are small in size (ranging from 0.05 to 0.59 km² in area) and disconnected from one another during dry seasons (Maya and Domínguez 1997).

Giganta oases are small wetlands found only in intermittent stream drainage ways (arroyos) and remain active year-round due to spring or seep water (León and Domínguez 2006); however, the geo-chemical processes giving rise to them are poorly understood. These oases are species-rich and diverse (Riemann and Ezcurra 2005). Year-round fresh water causes this habitat to support small forested areas with emergent marsh-like vegetation (León and Domínguez 2006) that harbor 259 endemic and microendemic species, including flora (León and Domínguez 2006; Riemann and Ezcurra 2005, 2007) and fauna (Bernardi et al. 2007; Ruiz-Campos et al. 2002). Giganta oases act as waypoints for resident and migratory birds (Erickson et al. 2008; Rodríguez-Estrella 2005) and make human life possible in this harsh and unforgiving landscape.

Sierra de la Giganta conservation issues

Over the last 10 years, international organizations (e.g., BirdLife International) and biologists (e.g., Rodríguez-Estrella 2005) have targeted the Giganta for conservation because of its economic and intrinsic value. Due to the unique nature of Giganta oasis ecology and its associated biodiversity richness, the region has been declared a priority terrestrial area for conservation (Arriaga et al. 2000), with some authors advocating for parts of the Giganta to become fully protected (Riemann and Ezcurra 2005). As of February 2008, 41,181 hectares of land in the Giganta were designated as Ramsar-protected wetland reserves (an intergovernmental treaty concerning the sustainable use of wetlands that have international importance). However, no active management plans exist.

Endemic species targeted for conservation include (1) the Baja killifish (*Fundulus lima* and *F. parvipinnus brevis*), which has been classified as “endangered” because of competition from exotic redbelly tilapia (Bernardi et al. 2007), and (2) Belding’s yellowthroat (*Geothlypis beldingi*), which has been classified as “critically endangered” by BirdLife International (Erickson et al. 2008).

Conservation biologists have implicated ranchero lifestyles and agriculture as primary vectors for oasis ecosystem decline (León and Domínguez 2006; Riemann and Ezcurra 2005; Rodríguez 2005). Suspected sources of habitat degradation include (1) the use of gasoline-powered pumps to transport oasis water; (2) the introduction of exotic invasive species, like buffel grass (*Pennisetum cillare*), rubber vine (*Cryptostegia grandiflora*) and redbelly tilapia (*Tilapia zilli*); (3) over-harvest of timber resources for charcoal production and (4) livestock trampling on and over-grazing of oasis vegetation. Although conservation biologists are rightly concerned about the long-term habitat functioning of Giganta oases, limited systematic evaluations exist concerning the extent to which ranching and water use serve as vectors for oasis habitat degradation. Of those oases receiving systematic examination, most occur in areas of relatively high ranchero population densities (e.g. León and Domínguez 2006). As such, it is difficult to generalize the impacts of anthropogenic disturbance of these oases to others located in the region.

Additionally, virtually no information exists concerning the oasis management strategies developed by rancheros themselves over the last two centuries. As primary stakeholders whose economic and cultural livelihoods have been shaped by this ecosystem over the last 230 years, it is very possible ranchero social institutions support the goal of long-term oasis ecosystem functioning. Furthermore, limited demographic profiles exist for specific watersheds within the Giganta. This is unfortunate, as internal and external population dynamics are known to affect

natural resources management strategies (Borgehoff-Mulder and Coppolillo 2005). Situating resident rancheros' choices in light of the historical, political and ecologic constraints will provide information necessary to build the current population's capacity to integrate itself into the growing global economy at a pace that maintains cultural integrity and promotes ecologic sustainability. The current research fills some knowledge gaps for a single watershed (Arroyo La Presa) in the southern Giganta.

Study site

Arroyo La Presa (hereafter referred to as ALP) is a rugged, 35-km dry riverbed located in the southern Giganta. The arroyo sits within a hot, dry valley. Two things dominate the landscape: the valley walls which rise some 800 m above sea level, and oases and *tinajas* (temporary, rain-fed pools that occur within the arroyo where bedrock is exposed) that dot the landscape and serve as the primary fresh-water source for biotic communities. The arroyo begins near Mesa Humi and trends in a southwest direction until it reaches Arroyo San Pedro. The arroyo's highest point exists in the north at approximately 400 m above sea level, its lowest point where it enters Arroyo San Pedro at approximately 200 m above sea level. Genetic analyses on endemic killifish species from oases within southern extent of the watershed indicate that a relict river once flowed from ALP to the Pacific Ocean during the Pleistocene (Bernardi et al. 2007).

ALP culture history

There is evidence for human presence in Baja California since the late Pleistocene (Davis 2003; Des Lauriers 2010). However, systematic archaeological investigations of ALP have only begun within the last three years. A single radiocarbon date from Cueva Santa Rita indicates humans have existed in the watershed for at least the last 4,000 years (Henrickson, personal communication). Systematic archaeological surveys indicate humans have occupied most areas of the watershed at some point in the past, especially areas adjacent to the arroyo. At the time of European contact (ca. A.D. 1530), the watershed was occupied by an indigenous culture known as the Guaycura who practiced a foraging lifestyle throughout the Giganta and Magdalena Plains (Baegert 1952; Barco 1981; Macfarlan and Henrickson 2010; Mathes 2006).

Between 1721 and 1740, Jesuit Father Clement Guillén established the first European-style building in the ALP watershed at the Guaycura site known as Chilla or Tauetia (Engelhardt 1908) in an attempt to convert the local population to both Christianity and a sedentary lifestyle. A visiting chapel was constructed, named La Pasión del Señor (hereafter referred to its Hispanic name, La Pasión), to indoctrinate a semi-settled group of Guaycura living in the area. Guillén was more permanently stationed at Mission Nuestra Señora de los Dolores Sur (hereafter referred to as Los Dolores) on the eastern peninsular coast site known as Apaté. In 1741, Guillén moved the base of missionary work from Los Dolores to La Pasión, where it was presided by father Lamberto Hostell and, later, his military escort Anastazio Verduzco (Crosby 1994). The visiting chapel was renamed and has since been referred to as La Pasión, Los Dolores, Mission La Pasión, La Pasión de Chillá and Mission de los Dolores Chillá La Pasión del Señor (Crosby 1994). In 1744, this location supported 159 people (Jackson 2004), and approximately 1,000 Guaycura lived in the region in five additional semipermanent locations. The Jesuits sought to create a stable and politically autonomous indigenous community based on the *pueblos reales* model of central Mexico (Jackson 2004).

However, the desert-mountain environment, compounded by the lack of large tracts of arable land, made agriculture difficult, and thus permanent settlement of the Guaycura remained problematic. To supplement the meager agricultural goods produced from this desert-mountain environment, the Guaycura continued to practice their traditional foraging lifestyle. The Guaycura population in the ALP watershed declined rapidly over a single generation, caused by a variety of factors related to colonization (Jackson 2004). Mission La Pasión operated until 1768, when by royal decree the Jesuits were expelled from the peninsula.

Following Jesuit expulsion, Mission La Pasión was closed and the remaining Guaycura population was forcibly moved to Todos Santos to work in agricultural fields at the initiative of Baja California *visitador general* José de Gálvez. The relocation was a failure, and many Guaycura returned to their ancestral homelands (Jackson 2004).

The following year, José de Gálvez granted ranching rights over ex-Jesuit mission lands in the southern Giganta to Felipe Romero, a retired military escort stationed in Baja California (Crosby 1994; Martínez 1965). By 1834, Pablo de la Toba and his family acquired formal property rights over the ex-mission lands of La Pasión, and in 1853 he acquired rights over the properties of Los Dolores and San Luis Gonzaga from descendants of Felipe Romero (Martínez 1965). Members of the de la Toba and Romero families reside in the ALP watershed today as part of the larger ranchero community. Over the last 231 years, these oasis-rancheros developed a unique culture shaped by the experiences occurring within this restricted habitat, with oases, desert landscapes and ranching forming the core of their social identity (Crosby 1981). Residents have a deep knowledge of the regional botany, specifically with reference to medicinal plants. Many rancheros suggest that botanical knowledge has been acquired through two mechanisms: (1) ancestors who relied on trial and error learning, and (2) horizontal transmission of information from the few remaining Guaycura who returned to the region after their forced relocation to Todos Santos.

ALP oasis-ranchero demography

Today, 30 ranchos and approximately 100 individuals exist within the ALP watershed. Residents state that ranchos vary in size from 500 to 5,000 hectares. The community in ALP is largely underdeveloped, lacking electricity, public sanitation, Western medical services and paved roads. Like many ranchero populations (Farr 2006), the community is poor, but well fed.

Unlike many impoverished rural communities, clean drinking water is abundant via oases. Houses are built in the traditional ranchero style and are constructed mostly from local materials. These houses are meager but well-adapted to the desert-mountain ecology. The family composition of 14 ranchos (51 individuals) was identified. Twelve contained a married couple, eight of which had children. Of the 51 individuals, 29 were adults, 22 children (< 18 years).

The pueblo of Toris has the largest population density in the watershed. Residents indicate the pueblo has approximately 50 permanent individuals divided into 13 ranchos. Toris contains a federally funded (CONASUPO) general store, one chapel, two schools, two dormitories, three wells (used for human consumption), and five oases (used for animal consumption). Toris experiences seasonal population increases as the result of an influx of students who live in the dormitories to attend primary and secondary school.

Consanguineal (blood), affinal (marriage), and fictive (*compadrazgo*) kinship ties dominate the social landscape. Nearly every rancho has at least one primary genealogical connection to another through these social bonds, giving weight to the impression that this community is “one

family”. This premise holds except for two ranchos that exist at the far southern extent of the arroyo along a partially maintained road. By local and national standards, these ranchos are wealthy, as they are constructed of materials largely obtained from urban areas. Immigrants of foreign and domestic origin own these ranchos.

ALP oasiana-ranchero water management

Twenty-seven oases were recorded within the ALP watershed. Most ranchos existed immediately adjacent to at least one spring. Norms dictate when ranchos are situated next to an oasis, those residents have primary user rights; however, others from the broader community may consume the water if need exists or if they are directly related to someone residing next to an oasis. As a result, most oasis water in ALP should be considered common property. Common property regimes occur when property is owned collectively and managed through controlled access via norms/institutions, such that owners have consumption rights to the exclusion of others on a discretionary basis (Borgerhoff-Mulder and Coppolillo 2005).

Nearly all residents agree that living next to a spring is vital for survival. When asked if water was a factor governing house location, one resident stated it was “vital”. Two ranchos did not exist next to an oasis. When asked why someone would establish a rancho without easy access to a spring, one respondent suggested, “*Ellos son locos*”, they (those living far from a spring) are crazy. Following the same logic, the colloquial name for one rancho that does not exist next to an oasis is El Imposible, because most residents believe it will be impossible for this rancho to thrive without an oasis. Ranchos distantly located from oases obtain drinking water from springs located next to other ranchos. Occasional gifts of goat, cattle, or fish meat are suggested to be common strategies for using another’s oasis. One rancho was located next to three oases. This family supplies approximately 550 gallons of water every week to another ranchero population residing at Llanos de Kakiwi (a Pleistocene lake basin located just beyond the northeast margin of Arroyo La Presa). The family residing next to these oases suggested they have never run dry in their or their deceased relatives’ lifetimes.

Residents acquire oasis water through several techniques. Some use buckets to move water from oasis to home, others use hoses to transport oasis water via a gravity feed, and a few use gasoline-powered generators to move oasis water. Many opt not to use gasoline-powered generators because of the cost associated with the device itself and the continual need to purchase gasoline, which is not available in the community and is costly to obtain. Ranchos located in greater proximity to the road were more likely to use gasoline-powered generators to transport oasis water. Residents state that a federally subsidized water-filtration tower may be built in the near future in the pueblo of Toris to accommodate the growing population and service the surrounding ranchos.

ALP oasiana-ranchero economy

Residents rely primarily on goat herding for subsistence and are proud to be known as a region that produces high-quality goats. Goats are sold live or are converted into meat and cheese products for personal consumption, and informal and formal markets. A survey of seven homes reveals a goat population of approximately 400 head. Cattle, horses, mules, donkeys, and a few chickens also are raised in the area. However, ecologic circumstances make large livestock ranching difficult (i.e., insufficient fodder for animals), and animal predators target domesticated

fowl. To supplement the pastoral economy, foodstuffs are purchased from the surrounding towns of La Paz, El Cien and Ciudad Constitución, as well as from a CONASUPO in the pueblo of Toris.

Individuals from ranchos located in the eastern extent of the watershed rely on a mixed economy of ranching and ocean fishing, with local climatic conditions dictating whether or not fishing is pursued. Residents state that ocean fishing is preferred to ranching in warmer months, not because fishing is more enjoyable, but because fishing provides greater returns per unit time. Products generated from fishing events are consumed by the individual and his/her family or marketed to other rancho families to diversify diets.

Additionally, households may fish for exotic invasive species, such as tilapia, that have been stocked in some oases to supplement the diet. However, the number of oases containing tilapia is not known at this point. Spot observations and unstructured interviews suggested at least one oasis in the eastern watershed contained tilapia, while two in the western watershed did not.

The oasis-rancho community of ALP is tied to the larger geo-political region through its association with Ejido Tepentú. Like the oasis water, *ejidos* are themselves common property regimes. Currently, Ejido Tepentú is undergoing massive demographic, social and economic transformation as the result of land neo-liberalization policies. Since 1992, Mexico has sought to modernize its agricultural sector by allowing former *ejido* lands to be parcelized and either rented or sold to other farmers or foreign investors. As of 2006, approximately 55% of the land associated with Ejido Tepentú has been sold to foreign and national investors (International Community Foundation 2006). Residents indicate that this transition has led to negative repercussions. For example, residents state one recent emigrant family that has purchased privatized *ejido* land consumes oasis water without following community norms governing oasis management. This family consumes oasis water from their own property, as well as oasis water from other ranchos (via a historically built irrigation channel) for agricultural production; however, this private household does not reciprocate with water for other ranchos. Additionally, residents state that this same family allows their livestock to graze on rancho properties other than their own. Because these emigrants are relatively wealthy, many in the community feel they have little power to enforce local rules.

Discussion

Humans have constructed an important niche within the Arroyo La Presa watershed for at least the last 4,000 years. Whereas prehistorically a foraging people known as the Guaycura inhabited the arroyo, it currently harbors an oasis rancho population. Historic rancho families acted as a link between these two groups by absorbing aspects of indigenous Guaycura traditional ecologic knowledge concerning biotic taxa and their use in medicine. Over the last 230 years, this knowledge has been passed via oral traditions to modern rancho families. As such, modern rancheros in the Giganta serve as information storehouses concerning cultural adaptations to this unique ecology. Historic records indicate the current population of Arroyo La Presa exists at levels approximately four to ten times lower than it harbored 230 years ago, just before the era of private ranching. Additionally, the population's current demographic profile indicates the region is experiencing either high youth emigration, low fertility or both, as there are a disproportionately large number of adults in the ALP watershed. Carino, Tompa, and Castorena suggest rancho populations in the Sierra de la Giganta are experiencing high emigration rates due to a lack of economic opportunities. This has caused fear that rancho culture may be lost within the next two generations (Living Roots 2011).

At this point, it appears that concerns that rancheros will over-consume oasis water are unfounded for this watershed, given the limited population size and its associated emigration. Although water transport via gasoline-powered generators presents a real threat to Giganta oasis conservation issues (e.g., excess discharge and noise pollution), given the limited number of households that rely on them, we feel this threat can be managed if appropriate alternatives are provided. At least one oasis had been stocked with invasive tilapia species for personal consumption. This is a problem and will likely effect overall ecosystem functioning if the practice spreads. Systematic exploration of each oasis will be required to determine the impact of this threat.

Oasis water in the ALP watershed is mostly common property; however, this does not mean the oasis water is open-access and therefore likely to succumb to a tragedy-of-the-commons style problem of overconsumption (Hardin 1968). Community norms established by rancheros themselves determine who has access to and consumption of water. Because their economic and cultural survival depends on the health of this ecosystem, it is likely they have the greatest incentives to protect it in perpetuity. Cross-cultural evidence suggests smallholder populations relying on common property regimes can sustainably manage common pool resources when communities have (1) secure property rights, (2) decision-making autonomy, (3) the ability to monitor behavior or punish offenders, (4) stable social relations and daily communication and (5) a slow rate of cultural change (Borgerhoff-Mulder and Copollilo 2005).

We believe the greatest threats to long-term oasis ecosystem functioning in the ALP (and other regions in the Giganta) stem from institutional changes occurring at the international and national level. Many analysts believe neo-liberal economic policies that link privatization of land with cash markets will cause agricultural productivity increases; however, others project that *ejido* land reform is unlikely to work in areas that lack modern social and economic infrastructure (Thompson and Wilson 1994), such as the community in ALP. Data from smallholder populations around the globe suggest neo-liberal land policies cause lowered social cohesion, factional community relations, and impeded decision-making related to common pool resources (Borgerhoff-Mulder and Copollilo 2005). When communities undergo rapid cultural change through immigration or emigration, lose their ability to monitor and punish norm violators, or lose trust in neighbors, common pool resources are less likely to be managed effectively. Narratives from residents within the ALP watershed indicate this is occurring.

To ensure the long-term viability of oasis habitats in the ALP watershed specifically, and Giganta more generally, policy analysts must consider the constraints and opportunities of the local population. As primary stakeholders in this context, efforts should be made to build the capacity of the ranchero population to act as stewards of the environment. Removing or diminishing the population's voice over oasis and land management can lead to conflict between local, regional or international stakeholders and may result in further degradation.

Education, material support and skill acquisition for monitoring environmental impacts will be important to facilitate the ranchero population's ability to better manage these resources.

Based on the cultural, historical and ecological importance of the Arroyo La Presa watershed, an ethos of collaboration is required between all stakeholders. Empowering the local ranchero population to define research questions, collect data, and use data for management decisions will support both ecological sustainability and cultural integrity.

Conclusions

This research reported cultural, demographic and hydrologic aspects of the Arroyo La Presa watershed to understand the human niche within this unique mountain oasis ecology. Like many small-scale, semi-bounded populations bonded by close genealogical connections, an ethos of communal property (but not necessarily open access) pervades the community. These norms allow the population, in conjunction with their livestock, to manage critically important oasis resources. However, habitat use comes not without problems.

Conservation biologists have identified ranching lifestyles, the importation of exotic species and water consumption as major vectors for oasis ecosystem degradation in the Sierra de la Giganta. These problems are present in the Arroyo La Presa watershed; however, they may not represent the biggest threat to oasis ecosystem functioning. Privatization of *ejido* land and its sale in commercial cash markets represent a threat to the *ranchero* community, as it erodes their ability to manage this common pool resource. The current population has deep cultural and historic ties to this landscape; as such, they are primary stakeholders in this environment. Efforts should be made to build the population's capacity to participate in ecosystem monitoring and management.

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