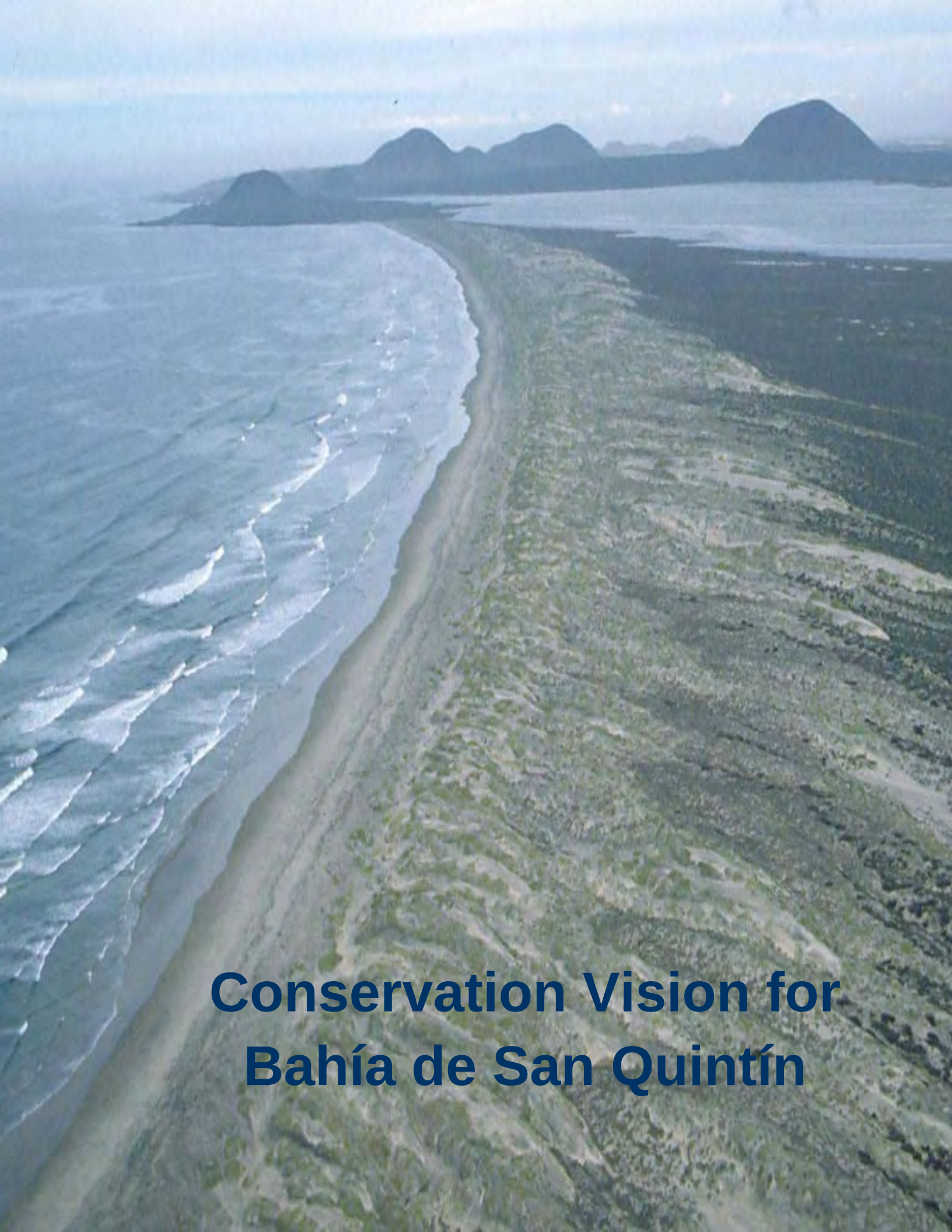

Conservation Vision for Bahía de San Quintín

Conservation Vision for Bahía de San Quintín

August 2007

Cover photo: Punta Mazo at San Quintín by Alan Harper

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Executive Summary

Bahía de San Quintín is the largest and only intact coastal lagoon system in the entire Mediterranean zone of North America. It is among the richest, most diverse, and most imperiled ecosystems on the planet, supporting dozens of species designated as Threatened or Endangered. Hidden in the fog on the windy Pacific Coast of Baja California, this sequestered spot is recognized worldwide for its biodiversity and its hemispheric importance to fisheries, waterfowl, migratory birds, and other coastal resources. The pristine condition of these ecosystems resembles that of Southern California more than 100 years ago, before their destruction and degradation due to population growth.

The survival of this remarkable landscape, however, is threatened by development pressures from a growing population and the thrust of tourism southward from the U.S. border. Like much of Baja California, the area does not have the infrastructure in place to support this growth or a complete recognition of its consequences on natural resources and the local economy. Sustainable use of the area's rich natural resources is vital to continued agriculture and aquaculture operations, tourism, and community growth. This document presents a vision for addressing these conservation and socioeconomic challenges through new partnerships and an integrative approach to conservation and management of natural resources within a sustainable human community.

A unique opportunity to conserve extraordinary resources

What makes this volcanic terrain so distinctive is the large concentration of imperiled resources in one place, each functioning as an irreplaceable piece of a dynamic ecosystem linking ocean life with coastal communities with the highest peaks of the Sierra San Pedro Mártir. This fragile landscape of stark, natural beauty has garnered international recognition for its diversity, number of endemic species, and rich marine resources, as reflected in:

- A remarkable complex of productive wetland systems comprised of estuarine lagoons, intertidal salt marshes and mudflats, vast eelgrass beds, and rocky points
- The most intact and diverse chain of coastal beaches and Aeolian dunes of the Baja California peninsula
- An upwelling of the California Current System bringing nutrient-rich waters to the bay, resulting in the largest aquaculture production in a single waterbody in México
- Irreplaceable wintering habitat for migratory waterfowl and shorebirds, including 30-50% of the black brant population on the west coast of México, a key staging area for fall and spring migration, and a reproduction site for gray whales
- Populations of 45 plant and animal species designated as Threatened or Endangered and over 50 species endemic to the region between Ensenada and El Rosario, with San Quintín at its heart

- One of Baja California's most extensive patches of coastal scrub, one of the most threatened ecosystems in North America
- One of the most productive and fastest-growing agricultural zones in Baja California
- Part of the last continental linkage through the Sierra Juárez to habitats north of the border

Synergistic threats and cascading impacts

Because these conservation targets are so inextricably linked, any impacts to one of them will have cascading effects on the others. Thus, the cumulative impacts of these threats will be exponentially adverse—to both the natural resources themselves and the human population that relies on them for its livelihood. Unregulated growth and consumption of resources coupled with unmonitored agricultural practices have already resulted in groundwater overdraft, a decrease in water quality, and loss and fragmentation of habitats. As a result, much of the local community at San Quintín bears a relatively poor quality of life, with limited water, infrastructure, and community services.

Large-scale construction of hotels and associated development is proposed for San Quintín—this could destroy the natural beauty and aesthetic values on which tourism depends. For example, a master planned subdivision for Monte Ceniza, the peninsula that bisects the bay, has already been authorized. The direct loss of habitat and associated indirect impacts of this project alone, if implemented as planned, would filter through the ecosystem, resulting in an altered hydrologic regime, increased groundwater overdraft, destabilization of the shoreline, runoff of sediments, nutrients, and toxic pollutants to the bay, introduction of nonnative species, disturbance to wildlife, degradation of fisheries and aquaculture resources, and other adverse consequences. While some level of development can be compatible with conservation of natural resources at Bahía de San Quintín, the impacts of incremental, unplanned, and unregulated growth would be irreversible and, over time, could lead to collapse of the bay's complex food web and associated ecological processes.

Commitment to an alternate future

In 2006, The Nature Conservancy (TNC) and Terra Peninsular coordinated the development of a Conservation Area Plan (CAP) which outlines multiple levels of public and private actions to conserve natural resources at Bahía de San Quintín within the context of a sustainable economy. The Coalition for the Protection of Bahía de San Quintín, an unincorporated alliance formed by Terra Peninsular A.C., Pronatura Noroeste, Pro Esteros, and TNC, will cooperate in fulfilling the CAP objectives. Over the next decade, the Coalition will grow to include local economic groups, private landowners, community leaders, and other institutions working together to implement a multi-pronged strategy that encompasses:

- Incentives for private land conservation, including acquisition or protection through other legal mechanisms
- Public designation of Bahía de San Quintín as a Natural Protected Area

- Obtaining international recognition of Bahía de San Quintín as a Ramsar site and Western Hemisphere Shorebirds Reserve Network
- Enforcement of municipal zoning and urban plans and the State's Ecological Zoning Plan
- Approaches for abating and mitigating threats to natural resources, focused on public education, outreach, and monitoring

The goals of the Coalition are ambitious but imminently workable. If successful, the outcome will be transformative for the region and a model for the entire peninsula of Baja California. The formation of the Coalition marks the beginning of a new future for Bahía de San Quintín, one that embraces a community paradigm of pride, ownership, and stewardship, through environmental education across all walks of life. The scope of this new paradigm will be manifested in:

- Private land acquisition, as a cornerstone of a larger conservation strategy
- An effective network of water management infrastructure
- Increased capacity for resource-based tourism
- Zoning and urban development plans that allow phased development according to infrastructure and resource capacity
- Incentives and regulations for efficient agricultural and extraction practices
- Self-monitoring procedures for aquaculture operations
- New partnerships and commitments within the community

The result will be an iconic and lasting landscape that embraces the biodiversity, productivity, and beauty of Bahía de San Quintín. This legacy will persist as a testimony of the community's commitment to a sustainable future.

I Introduction

Located on the Pacific Coast of Baja California, approximately 325 km south of the U.S.-México international border, Bahía de San Quintín is the largest and only intact coastal lagoon system in the entire Mediterranean zone of North America (Figure 1). This fragile region of stark natural beauty—the southernmost component of the California Floristic Province—is among the richest, most diverse, and most threatened in the world.

Biodiversity—the array of life on Earth, including all its different organisms, their genetic codes, and their interconnections within ecosystems and communities.

The conservation significance of Bahía de San Quintín is recognized worldwide for its biodiversity and its hemispheric importance to fisheries, waterfowl, migratory birds, and other noteworthy coastal resources. However, development pressures from a growing population and the thrust of tourism southward from the U.S. border are threatening its survival. Without a plan for sustainable human use of the region, including the bay and its natural resources, *effective conservation* will not be realized.

This document presents both a vision for effective conservation action in Bahía de San Quintín and a conceptual approach to achieve it.

Effective conservation—protection that is sustainable through enforced land use designations, integration within working landscapes, or long-term management.

A quiet past

Bahía de San Quintín was formerly christened as the *Bay of 11 Martyred Virgins* by the Portuguese explorer Juan Rodriguez Cabrillo in 1542. Cabrillo's inspiration was Saint Ursula, a Roman maiden with 11 ladies-in-waiting, all of whom were martyred when Ursula refused to marry a chief of the Huns in Germany. Sixty years later, the Spaniard Sebastian Vizcaíno renamed the place *San Quintín*, in honor of Saint Quentin, another Roman who was beheaded in France in the 3rd century because of his evangelical movement.

Centuries later, in 1884, President Porfirio Díaz granted huge land concessions to the New York-based International Company of México. In anticipation of a productive agricultural center, the company built flour mills and port facilities and planned a railway to San Diego to attract settlers from the United States. After many failed seasons, in 1890 the International Company of México sold out for $7 million to the English Land Company, and British colonists constructed a grist mill, customs house, port, and 30 km of the San Diego railway. This effort also was defeated by successive droughts, and now the only remnants of these enterprises are the ruins of a pier, machinery at the old mill (now The Old Mill motel), and an English cemetery.

Today, the area looks almost exactly as it did when it was discovered by Juan Cabrillo and Sebastian Vizcaíno 4 centuries ago. Bahía de San Quintín is known for its great sportfishing, a thriving oyster farming industry, and dramatic landscapes of clouds, waves, dunes, and dark volcanic cones, and Valle de San Quintín is known for its strawberries and tomatoes, among other agricultural products.

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Bahía de San Quintín

Figure 1 - Location of Bahía de San Quintín within the South Coast Ecoregion

Ecological significance

Ecosystem—a dynamic complex of plants, animals, and other organisms that interact with one another and their non-living environment as a unit.

Bahía de San Quintín and its surrounding natural habitats encompass over 26,000 hectares [1 hectare (ha) = 2.471 U.S. survey acres] of globally imperiled communities, including remarkable examples of coastal lagoon supporting mudflats and eelgrass beds, coastal salt marsh, and intertidal wetlands. The system of coastal beaches and Aeolian dunes between Ensenada and Bahía de San Quintín is the most intact and most diverse of the Baja California peninsula (Johnson 1977). The coastal sage scrub around the bay is one of the most extensive patches in the State of Baja California and one of the most threatened ecosystems in North America. The pristine condition of these ecosystems resembles that of Southern California more than 100 years ago, before their destruction and degradation due to population growth.

Endemic species (endemism)—species restricted in distribution, occurring nowhere outside a defined geographic area, such as a particular location (narrow endemic) or ecoregion (regional endemic).

These habitats are critical to numerous species of sensitive plants and animals, including 45 species listed as endangered, threatened, rare, or subject to special legal protection under the Mexican environmental law, and over 50 regionally endemic or narrow endemic species of plants and animals. Additional bird and plant species of this area are listed as endangered and threatened by the U.S. Endangered Species Act and California Endangered Species Act (Appendix A).

Vast beds of eelgrass (*Zostera marina*)—a globally declining resource—provide nursery areas for fish and invertebrates and constitute the base of the bay's diverse food web. Bahía de San Quintín is an irreplaceable wintering habitat for migratory waterfowl and shorebirds, including 30-50% of the black brant (*Branta bernicla nigricans*) population on the west coast of México (Massey and Palacios 1994). The bay serves as a key staging area for fall and spring migrations (Ward et al. 1993), sheltering more than 25,000 migratory shorebirds during the winter (Page et al. 1997). The gray whale (*Eschrichtius robustus*) has used Bahía de San Quintín as a reproduction site since the 1970s.

What makes this area so distinctive is the concentration of so many imperiled resources in one place, each functioning as an irreplaceable piece of a dynamic and complex ecosystem linking ocean life with coastal communities and across a broad terrestrial gradient of habitats and elevations to the highest peaks in the Sierra San Pedro Mártir. This sequestered part of the ecoregion embodies the energy of ecological processes as yet unrestrained by human intervention.

Socioeconomic context

San Quintín and adjoining Vicente Guerrero and Lázaro Cárdenas, all part of the Municipio de Ensenada, form the largest population center between Ensenada and Ciudad Constitución and one of Baja California's richest and fastest-growing agricultural zones. A booming agricultural industry, with 47,000 ha in cultivation, has attracted immigrants from mainland México, swelling

the local population to over 40,000. Cash crops such as tomatoes, strawberries, artichokes, and flowers are grown primarily for export to the United States. As the area receives very little precipitation, and surface water is limited, fields are irrigated with groundwater pumped from the local aquifer. Substantial overdraft of the aquifer has resulted in salt water intrusion in many areas, driving agriculture farther eastward to the foothills. Studies estimate the local water supply could be depleted within less than a decade. Moreover, the relatively dry surface soils of these drip-irrigated lands are easily blown away by strong winds moving onshore from the Pacific Ocean, resulting in serious soil erosion.

In stark contrast to its rich agricultural resources, much of the local community bears a relatively poor quality of life in general, with limited water, infrastructure, and community services. The small group of large growers has brought in thousands of workers from poor Mixtec, Zapotec, and Triqui villages in Oaxaca to harvest the crops. At first, migrant families lived in labor camps and returned to their homes at the end of each harvest season. But as the years went by, many decided to stay in the valley, and the pressure for housing has escalated. As the permanent population grew, so did discontent. In 1988, encouraged by human rights organizations, over 1,000 tomato and strawberry pickers organized a strike to protest the low wages, long hours, and unsanitary living conditions, often living in the arroyos. Their efforts to form an independent union were broken, however, and the strike's leaders fled to the U.S.

Bahía de San Quintín is one of the most productive coastal bodies on the northwestern coast of México. The upwelling of deep, nutrient-rich waters supports several profitable and non-polluting aquaculture operations, which require high quality water. The abundance of Japanese oysters (*Crassostrea gigas*) and other bivalves such as clams and mussels contributes to the primary productivity and filtering of heavy metals and thus the commercial importance of the bay. It is estimated that the annual production of 2,500 metric tons of bivalves—the largest aquaculture production in a single waterbody in México—is only about 40% of the actual capacity and exceeds $2 million annually (Aguirre et al. 1999). The over 60 species of crustaceans are important commercially as well as ecologically, serving as a trophic link between fish and birds. Moreover, Bahía de San Quintín is a spawning area and nursery for commercial fish and is recognized as one of three principal areas of reproduction for the northern anchovy (*Engraulis mordax*) on the west coast of the Baja California peninsula. Salt mining and extraction of beach pebbles also rely on the bay's resources, but have not been adequately monitored for their impacts on coastal resources. The rich food supply around the shore of Bahía de San Quintín attracts about 25,000 black brants every year, and annual hunting is a tradition that goes back many years. One of Ernest Hemingway's sons was a regular visitor to the area during hunting season.

Due to its relative isolation and inclement weather, Bahía de San Quintín has thus far escaped the intensive development pressures that have destroyed most coastal lagoons and wetlands in Southern California and northern Baja California. But recreational opportunities, combined with the relatively low cost of ocean-front property in Baja California, are beginning to attract American citizens and investments to the area. Scattered seasonal and permanent homes have been built around the bay, and a subdivision plan has been approved for one of the primary tracts of land important for conservation of the area. Whether this subdivision plan will ultimately be

implemented is questionable, but it is likely that sooner or later another development scheme will be approved and implemented for Bahía de San Quintín.

However, any new development will be capital-intensive because of the necessary infrastructure costs. Projects with large capital investments are particularly sensitive to fluctuations in demand, interest rates, and the economic climate in México and the U.S. Many large resort developments in Baja California have had similar economic problems. Some have gone bankrupt, while others have been auctioned off at a fraction of their costs. For example, in 1998 Bajamar, developed by GrupoSitur north of Ensenada, sold for 3% of its previously appraised value (Biberman 1999). Other projects that are much more accessible to American tourism, such as the Baja Beach and Tennis Club, have failed completely and have been semi-abandoned because their environmental costs have been huge.

A privately funded study conducted by the nonprofit Mexican Institute for Competitiveness (IMCO), based in Mexico City, criticizes developers' growing tendencies to appeal to the high-end tourist market through luxury hotels and golf courses, because these have placed increased demands on Baja California's scarce water supply. The study concludes that this style of development is not economically competitive and is not sustainable (Dibble 2007).

Vision of success—a fine balance

Bahía de San Quintín, its natural resources, and its surrounding human community are at a crossroads. The conservation and socioeconomic challenges that lie ahead can be addressed only through a comprehensive, ecosystem-wide approach that integrates management of environmental resources with a sustainable human community. A commitment to maintain the current landscape, with all the power, energy, and richness that it represents, will instill a sense of confidance, unity, and certainty in the future for the local community, without the threats of outside development that could cause upheaval in their lives. Development of new partnerships will solidify the community around the stewardship of this globally significant landscape.

2 Conservation Significance of Bahía de San Quintín

Hemispheric and ecoregional context

Biodiversity hotspots—those areas of the Earth supporting the greatest concentrations of living species, especially those endemic to a region.

Leading conservation scientists have identified 25 global biodiversity hotspots—conservation priorities representing *irreplaceable* resources for preventing species extinctions—known to support remarkable biodiversity and concentrations of endemic species, many of which are globally imperiled (Mittermeier et al. 1999). Three of these hotspots are in the northern hemisphere of the New World—the California Floristic Province, the Caribbean, and Mesoamerica. Bahía de San Quintín anchors the southern end of the California Floristic Province, which stretches from Northern California to El Rosario in Baja California (Figure 1). The California Floristic Province, one of five floristic provinces in the world defined by a Mediterranean climate (hot, dry summers and cool, moist winters, mediated by proximity to oceans), is one of the richest plant assemblages in the world. It supports about 25% of all plant species north of mainland México, and about half of these species are endemic to the province (Mittermeier et al. 1999, Raven and Axelrod 1995).

The South Coast Ecoregion is that portion of the California Floristic Province generally south and west of the Transverse and Peninsular mountain ranges along the Pacific Coast (Figure 1). This ecoregion mixes a complex array of geological substrates, topographic features, climatic regimes, soil types, and other physical factors. The dramatic series of mountain ranges also serve as barriers to plant and animal dispersal, thus isolating this area somewhat from other ecological communities and species. The result is a natural laboratory of speciation and ecological innovation that has made the South Coast Ecoregion a *hotspot within a hotspot*. Its location on the edge of the continent, moderate climate, and natural beauty have also made the South Coast Ecoregion a magnet for human development, especially along the coast. The loss and fragmentation of habitats associated with this development have devastated populations of species with highly restricted distributions, resulting in a high degree of species endangerment and corresponding regulatory restrictions on development.

Coastal development in Baja California has all but eliminated coastal vegetation communities between Tijuana and Ensenada. Development of a huge port facility at Colonet, north of San Quintín, is planned to rival trade with ports at Los Angeles and Long Beach, and increasing urban and agricultural development at El Rosario, south of San Quintín, will eliminate and fragment the southernmost vegetation communities of the South Coast Ecoregion. Therefore, future loss of coastal habitats at Colonet further emphasizes the importance of conserving the last representation of these ecosystems in México, which support a very different species composition than coastal communities north of the border. In its remote location at the southern end of the South Coast Ecoregion, Bahía de San Quintín has, until recently, not experienced these same development pressures, but this fragile area has not escaped international recognition by scientists for its diversity, abundance of rare species, and rich marine resources, as evidenced by the following acknowledgements:

- Área Especiale de Conservación (Special Conservation Area) as defined by the Plan de Ordenamiento Ecológico del Estado de Baja California (POE)
- High Priority Region (CONABIO 1998 and 1999)
- Priority Marine Region for México (CONABIO/USAID/WWF/FMCN/PACKARD in Arriaga Cabrera et al. 1998)
- Important Marine Zone for conservation in the peninsula of Baja California (Enríquez-Andrade, R., y G. Danemann 1998), valued for the conservation of the Coastal Marine Ecosystem associated with the upwelling of the California Current (Olson and Dinerstein 1998)
- National Priority of the Global Representative System of Marine Protected Areas (IUCN 1995)
- Coastal and Marine Zone of México, among the high-priority conservation areas (Almada Villela/WWF 1992)
- Center of Diversity of Plants (WWF/IUCN 1994-1997)
- World Area of Endemic Avian Species and a Priority for Conservation of Biodiversity (Statersfield et al./Birdlife International 1998).
- Área de Importancia para la Conservación de las Aves (AICAS—Important Bird Area), due to its habitat condition and location along the Pacific Flyway (CONABIO and Bird Life International)
- One of the highest ranking portfolio sites in The Nature Conservancy's (TNC) ecoregional analyses for both terrestrial and marine systems
- Proposed as a Ramsar site
- Proposed as a Western Hemisphere Shorebirds Reserve Network

The reason for this level of recognition is clear—Bahía de San Quintín is the only *intact* bay system in the South Coast Ecoregion. Eight other bay systems in the ecoregion have experienced losses of between one-third to one-half of their natural habitats due to impacts of development, industry, and agriculture (Figure 2, Table 1). In fact, the intertidal plain at Bahía de San Quintín, which demonstrates the relationship between topographic heterogeneity and vegetation patterns, has been studied as a reference system for the restoration of highly fragmented and degraded marshes in Southern California (Morzaria-Luna et al. 2004). The environmental heterogeneity of the tidal creeks and salt marshes at Bahía de San Quintín creates a complex mosaic of substrates with varying structure, hydrology, and chemistry.

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Figure 2a - Series of Bays

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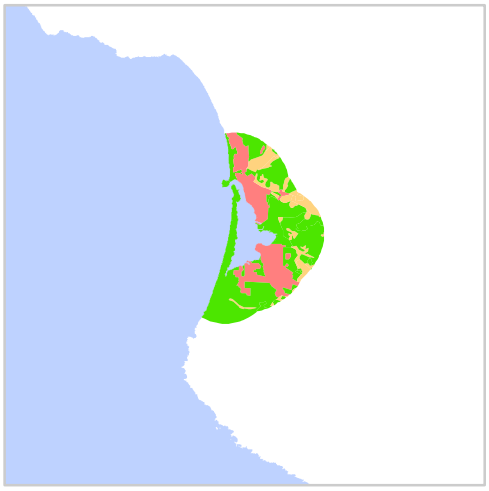
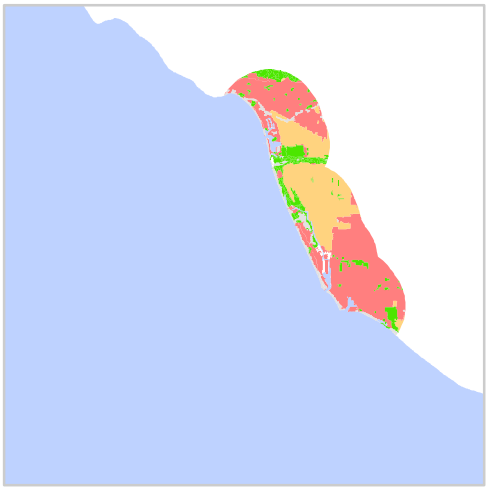
Figure 2b - Land Cover Comparison of Bays

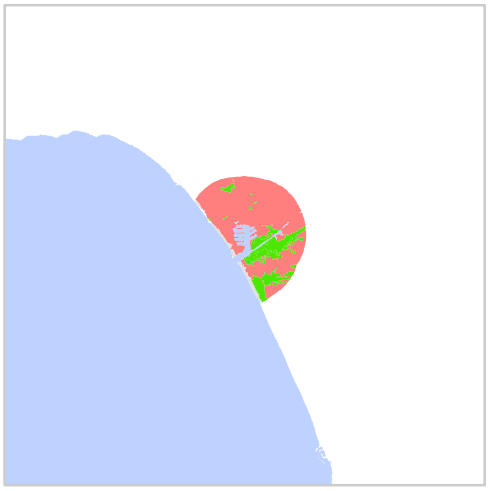
Morro Bay



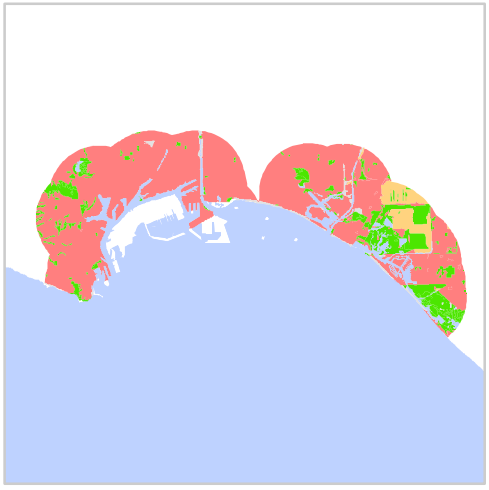
Ventura - Oxnard Harbor



Marina Del Rey - Ballona Lagoon

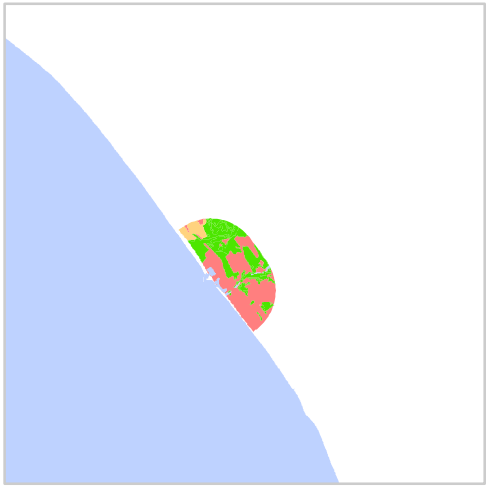


Los Angeles - San Pedro Bay

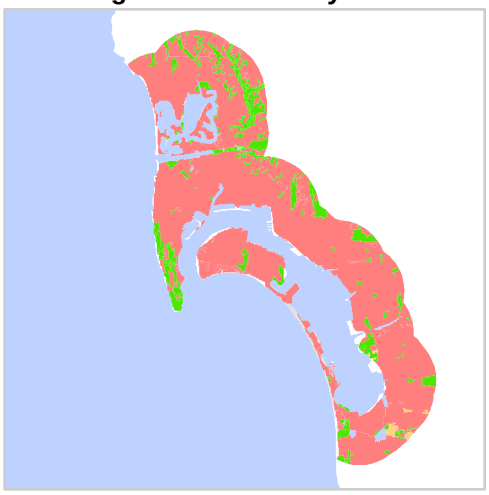


Newport Bay

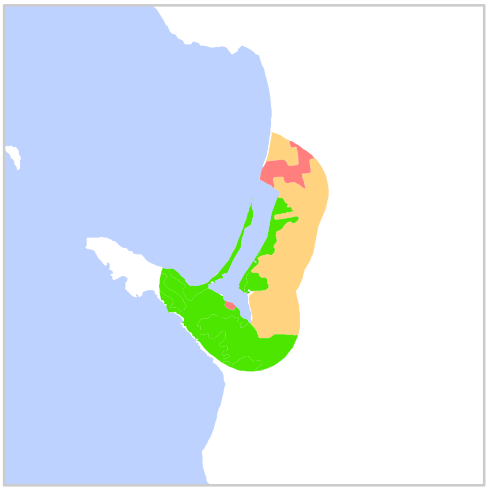
Oceanside Harbor



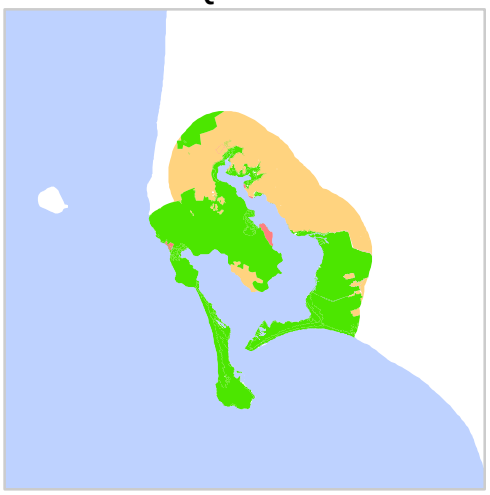
San Diego - Mission Bay



Ensenada - Bahía de Todos Santos



Bahía de San Quintín



- Urban
- Natural
- Agriculture

The interior shorelines of these bays were buffered a distance of 2 miles, creating a polygon that was used to clip the land cover data available for each area.
Morro Bay - CA Department of Conservation FMMP, 2002
Ventura through San Diego - CA Department of Foresty eVeg, 2002.
Ensenada - "BC_Veg_IF2000"
San Quintin - "SQN_Wetlands"

N

1:500,000

0 1.25 2.5 5 7.5 10 Miles

Table 1. Development impact in a series of bays—north to south—in the South Coast Ecoregion.

Bay	Urban	Agriculture	Barren	Natural & Water
Morro	16%	8%	0%	77%
Ventura Oxnard	29%	16%	3%	52%
Marina del Rey	47%	0%	2%	51%
Los Angeles/San Pedro	43%	3%	1%	52%
Newport	47%	0%	1%	51%
Oceanside	26%	3%	0%	71%
San Diego Mission	49%	0%	0%	50%
Ensenada	4%	29%	0%	67%
San Quintín	**0%**	**22%**	**0%**	**78%**

The structural integrity and complexity of Bahía de San Quintín is the basis for its reputation as irreplaceable wintering habitat for waterfowl, shorebirds, and raptors in the northern hemisphere; these species use the bay's rich source of eelgrass, invertebrates, and fish as a food source and prey base. Moreover, physical and ecological conditions at Bahía de San Quintín strongly influence population dynamics of migratory birds at both their wintering and breeding areas in the northern hemisphere (e.g., see box, next page, on black brant studies). Bahía de San Quintín is the only place where the black rail (*Laterallus jamaicensis*) has been sighted on the Pacific Coast of Baja California (Erickson 1992), and the area provides nesting and foraging habitat for several threatened and endangered bird species on the Pacific Coast of North America, including the western snowy plover (*Charadrius alexandrinus nivosus*), light-footed clapper rail (*Rallus longirostris levipes*), northern harrier (*Circus cyaneus*), peregrine falcon (*Falco peregrinus*), burrowing owl (*Athene cunicularia*), and short-eared owl (*Asio flammeus*), among others (Appendix A). It also supports over 50 species endemic specifically to the region around Bahía de San Quintín (i.e., narrow endemics, Appendix A). Therefore, given the loss of similar habitats in the ecoregion, and the remarkable diversity of intact habitats remaining at the southern end of the ecoregion, Bahía de San Quintín and its surrounding ecosystems present a unique opportunity to conserve an extraordinary representation of the original coastline.

Currently, there are no designated conservation areas along the coast of Baja California (Valle de Los Cirios is much farther south). Conservation of Bahía de San Quintín represents the last opportunity to preserve a representation of this globally imperiled ecosystem.

Pivotal role of Bahía de San Quintín in ecosystem dynamics of the northern hemisphere

For over 30 years, Bahía de San Quintín has provided a remarkable laboratory for ecological studies. One notable example is the research being conducted by the U.S. Fish and Wildlife Service (USFWS) and U.S. Geological Survey (USGS) on the black brant. Brant use of bays along the Pacific Coast is directly related to the abundance of eelgrass, its primary food. Approximately 30-50% of the brant population on the west coast of México winters at Bahía de San Quintín. The significance of the undisturbed ecosystems at San Quintín to the black brant has increased as loss and degradation of estuarine wintering habitats elsewhere have resulted in population declines of the brant along the Pacific Coast. Rich and undisturbed wintering habitat is critical to the physiological condition of these pre-nesting birds, and the stored nutrient reserve they carry on their long migration to breeding sites influences their subsequent reproductive success. Disturbance by hunters, natural predators, boat traffic, and aircraft in wintering areas is expected to reduce foraging time, increase energetic costs, and thus lower fat deposition, which may compromise the brants' physiological condition and result in lower reproductive success.

USFWS and USGS have monitored reproductive success of a marked population of black brants on their breeding grounds in Alaska since 1985, relative to El Niño events and their effects on eelgrass (Sedinger et al. 2006). The abundance and distribution of eelgrass decrease during El Niño years, when sea surface temperatures rise (Cabello-Pasini et al. 2003). Sedinger et al. 2006 found that fewer brants wintered in México during El Niño years, and fewer brants were observed on their breeding grounds in Alaska following El Niño years. Thus, the presence of rich and undisturbed wintering habitat at Bahía de San Quintín, in the southern part of the northern hemisphere, strongly influences winter distribution of brants and other species, which in turn affects ecosystem dynamics in the northern part of the northern hemisphere (Sedinger et al. 2006).

Landscape context

Bahía de San Quintín lies in a landscape of rolling coastal plains between Colonet on the north and El Rosario on the south, extending inland to the Sierra San Miguel foothills and ultimately to the Sierra San Pedro Mártir on the east (Figure 3). Llano de Camalu forms the northern portion of the rolling coastal plain, and Valle de San Quintín forms the broad southern portion, bordered by a row of extinct volcano cones to the west and the Sierra San Miguel on the east. Several small arroyos cross the Valle east to west, with the principal ones—Arroyo San Simón and Arroyo Santo Domingo—draining directly to the bay and to the Pacific Ocean, respectively. This system of coastal plains, drainages, and ridges functions as a single landscape with intact ecological processes.

Maintaining the integrity of this landscape is crucial to maintaining ecological functions and dynamic processes in the surrounding region. These ecological processes include nutrient and energy flow through food webs, population dynamics, gene flow, and species interactions such as predation and competition. For example, runoff from Sierra San Pedro Mártir has the potential to affect the water quality and hydrology of the watershed for the bay, so any development in the Sierra San Miguel or Sierra San Pedro Mártir must consider these impacts.

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Figure 3 - Landscape Context

Connectivity between coastal and inland ecosystems is essential to their long-term sustainability. Landscape-scale linkages between Sierra San Pedro Mártir and Bahía de San Quintín allow movement of demographic and genetic information across large elevational gradients; these linkages are important to finding refugia, supporting species population dynamics, and allowing evolutionary change, particularly in response to events such as catastrophic wildfires or long-term climate change. Landscape-level connectivity is important for terrestrial species with large home ranges, such as mountain lions (*Felis concolor*), to maintain an adequate area of habitat, and it is also critical for multi-generational dispersal of smaller animals and plant species.

Furthermore, the Peninsular Ranges—Sierra San Pedro Mártir and the Sierra Juárez farther north—may be the last landscape-scale linkage to habitats north of the border, so maintaining connectivity to this landscape is critical for long-term sustainability on a continental scale on both sides of the border.

Conservation focus area

The area of conservation focus extends along the Pacific Coast from the mouth of the Rio de Santo Domingo on the north, to El Socorro on the south, and inland to the agricultural lands in Valle de San Quintín (Figure 4). The most dramatic features of this area are the seven cinder cones—six on the peninsula and one on Isla San Martín—frequently shrouded by fog or low clouds. The reddish volcanic rocks are a striking contrast to the light-colored granite in other parts of the landscape.

To the south of the bay, El Rosario constitutes the southernmost distribution for coastal scrub; in this area, the species composition of this scrub community transitions to more desert species. Relict sand dunes from the last glaciation also occur at El Rosario, which is facing increasing development pressures. Important archaeological sites as well as terrestrial and marine fossils from the upper Cretaceous are found in this area.

Morphology and geologic origin

The morphology of Bahía de San Quintín was influenced by volcanic activity and changes in sea level during the Pleistocene. Originally, Campo Volcánico de San Quintín consisted of 12 cinder cones, spaced irregularly over a 190 km^2 area. Volcanic activity from Volcán Sudoeste (at the northern head of the current peninsula) and Monte Mazo (at the southern tip, or Cabo San Quintín) formed the watershed of Bahía Falsa. Strong surf created a sand bar—El Playón—and series of dunes along these historic lava flows. This chain of coastal dunes also extends north to Arroyo de Santo Domingo, enclosing a smaller hypersaline coastal lagoon and salt flats known as Laguna Figueroa.

Bahía de San Quintín was formed by a fluvial depression in the coastal plain. The lagoon sediment is principally marine, although there is significant terrestrial input from Arroyo San Simón during intense winter rains. Mesa de San Simón to the east of the bay was formed by conglomerates from the Pliocene, composed of fragments of granite and metamorphic limestone, cemented by a clayey-sandy matrix. The broad range of geologic origin has provided diverse substrates for supporting a unique variety of plant and animal species.

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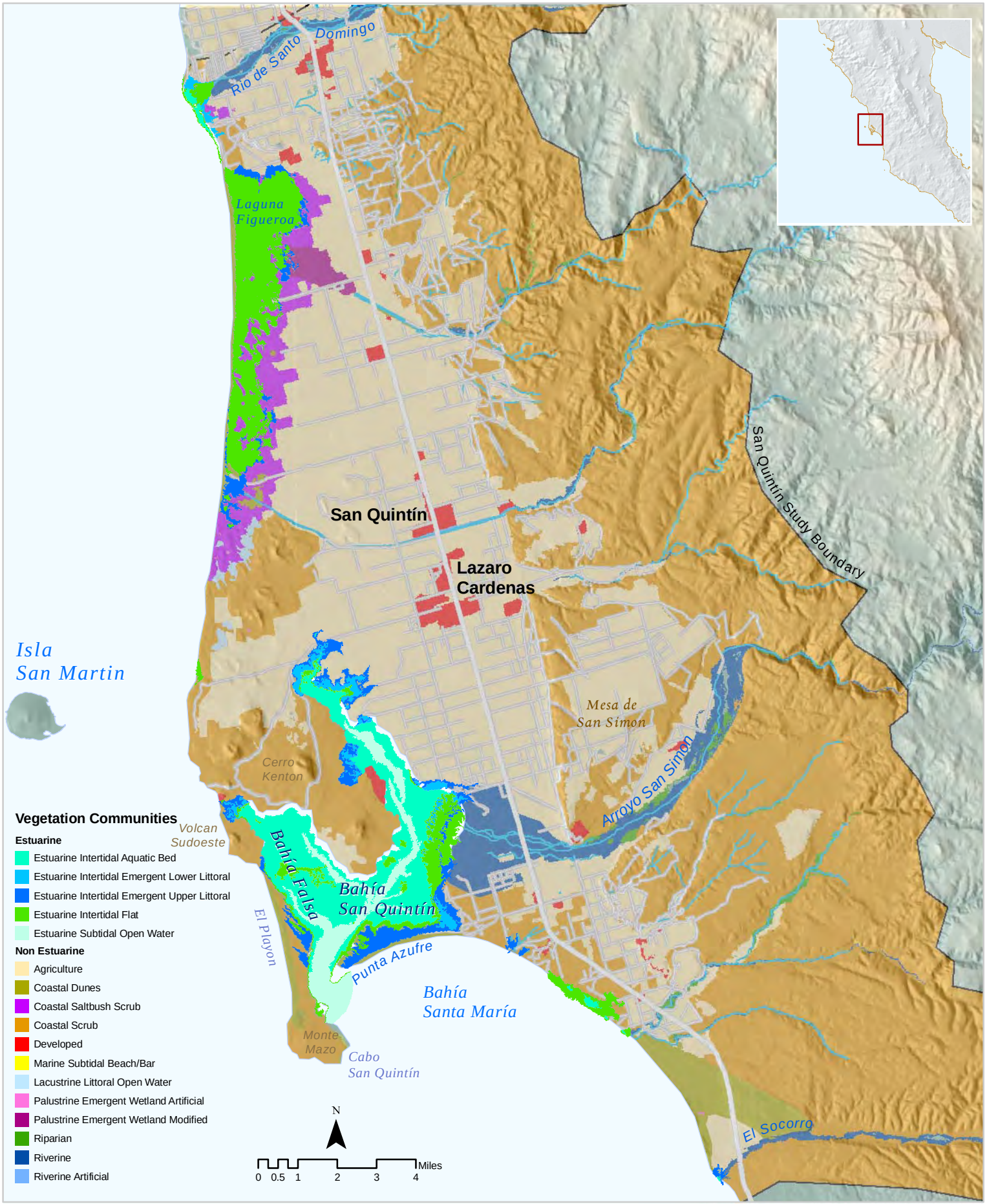
Figure 4 - Vegetation Communities



The two arms of the main bay—Bahía de San Quintín on the east and Bahía Falsa on the west—are divided by a volcanic peninsula whose principal cones are Monte Ceniza to the south and Cerro Kenton to the north. Punta Azufre divides this system from Bahía Santa María to the south, which is bordered by a long coastline.

Bahía de San Quintín and Bahía Falsa together cover about 42 km^2, with an average depth of 2 m and a volume of approximately $90x10^6$ m^3. The mouth of the bay is permanently open to the ocean, so there is regular and complete tidal exchange. A persistent upwelling at the mouth provides a large quantity of nutrients to the system, and high winds influence water circulation in the bay. This dynamic transfer of energy is key to sustaining the bay's ecology.

Hydrology

The conservation focus area is part of the Baja California Noroeste-Ensenada hydrologic region, which includes the Arroyo Escopeta-Arroyo San Fernando watershed and two of its sub-watersheds—Arroyo La Escopeta and Arroyo San Simón. Within these subwatersheds, ephemeral arroyos—La Escopeta, Nueva York, Agua Chiquita, and San Simón—drain to Bahía de San Quintín and Laguna Figueroa. Approximately 5% of the drainage comes from Sierra San Pedro Mártir, with Arroyo San Simón being the principal drainage to Bahía de San Quintín.

The area has a dry Mediterranean climate, with less than 50 mm precipitation per year, but up to 200 mm in El Niño years. As a result of population growth associated with the increase in agricultural use, the groundwater aquifer in this region has been over-drafted since 1974. This has resulted in the intrusion of saltwater to the aquifer. Recharge to the groundwater aquifer occurs only in years when rainfall exceeds 200 mm, which happens irregularly, about 25% of the time of record. Thus, the use of groundwater in the region is not sustainable and has caused serious social and economic problems over the past decade.

Ecology

The unique physiographic conditions described above are the basis for the intact ecological processes and diversity of vegetation communities in the area—a remarkable complex of highly productive wetland systems comprised of estuarine lagoons, intertidal salt marshes and mudflats, eelgrass beds and rocky points, surrounded by long stretches of coastal dunes, open sandy beaches, and vast expanses of coastal scrub, laced with ephemeral riparian systems. It is no wonder that this relatively undisturbed area—a vision into the former beauty and integrity of the Pacific coastline—has been the focus of scientific study for the last 30 years, thus providing a biological baseline for evaluating future changes in the region.

The relatively undisturbed habitats comprising the bay and surrounding communities support an astounding diversity of species that are endangered, rare, or endemic to the area (Appendix A), representing a convergence of flora and fauna with both tropical and temperate affinities. Persistent fog in this coastal desert region, almost constant in the summer, is also a determining factor in the vegetation and species that occur here.

3 Conservation Targets

The Nature Conservancy's Conservation Action Plan (TNC 2007), or CAP, can guide the development of conservation strategies for the unique, but interdependent, communities at Bahía de San Quintín. This approach involves assessing *ecological integrity* or *viability* for various *conservation targets* (e.g., an individual species or an entire community) by identifying *key ecological factors* (conditions or processes) that sustain the targets. Identifying the key ecological factors requires understanding how various physical or ecological conditions and processes affect the conservation targets. The relationships between the ecological factors, the conservation targets, and how they are impacted by sources of stressors (threats) are used to inform and integrate conservation actions for the ecological system as a whole.

Ecological integrity—the degree to which an ecosystem retains its naturally functioning parts and processes, without adverse modifications by humans.

The CAP planning process was undertaken at public workshops and smaller committee meetings, attended by representatives of local academic institutions, civic organizations, government officials, and the community of San Quintín. Table 2 summarizes the results of these discussions by identifying the conservation targets, key ecological factors, and indicators of viability for Bahía de San Quintín. Conservation strategies were subsequently developed based on hypothesized differences in how specific management actions differentially affect conservation targets via key ecological factors. Defining conservation strategies requires considering our scientific understanding of the ecology of each community, the responses of each community to major stressors or threats (discussed in section 4), and the existing and desired conditions for each conservation target. In addition, resources in Bahía de San Quintín must be managed adaptively to account for existing uncertainties in our understanding of this complex system and unexpected management responses.

The following sections describe the conservation targets for the conservation focus area at Bahía de San Quintín. In general, these conservation targets are currently in good condition, and their conservation viability is considered high. The conservation functions and values of Bahía de San Quintín depend on the integrity and interrelationships among these components.

Sand beaches and dunes

Tidal prism—the change in the volume of water covering an area, such as a wetland or bay, between a low tide and the subsequent high tide—important to maintaining the ecology of the system.

The system of coastal beaches and Aeolian dunes between Ensenada and Bahía de San Quintín is the most intact and most diverse of the Baja California peninsula, supporting several species that reach the southern limits of their distributions at Bahía de San Quintín (Johnson 1977). This fragile system serves as a buffer between marine and terrestrial processes, protecting the bay from sand transported by wind and wave action. Removing or destabilizing the dune system can increase the quantity of sand transported into the bay, thereby reducing the volume of its tidal prism and impacting tidal flushing and nutrient circulation. Plant species such as sand verbena (*Abronia maritima*) and sea-rocket (*Cakile maritima*) are important in maintaining the structure of the dunes.

Table 2. Conservation targets, key ecological factors, and indicators of viability for the conservation focus area around Bahia de San Quintin.

Conservation Target	Category	Key Ecological Factor	Indicator
Sand beaches and dunes	Landscape context	Geomorphology	Percent area of extraction of beach pebbles
		Topography	Height of dune
	Condition	Diversity of species	Diversity of plant species
	Size	Size (areal extent) of the dunes	# Ha
System of wetlands	Condition	Species composition and dominant species	Presence of birds
			Proportion of trophic groups of polychaetes
		Floristic composition and structure	Diversity of halophytic plant species
			Percent of halophytic plant species
		Areal extent of eelgrass beds	# Ha
Coastal scrub	Landscape context	Landscape structure	Area of coverage by successional communities
			Index of fragmentation
	Condition	Faunal composition and structure	Presence of key predators
			Presence of Argentine ants
		Floral composition and structure	Spatial arrangement
			Vertical and horizontal structure
			Proportion of native vs nonative species
Bays	Landscape context	Hydrodynamics and morphology	Bathymetry
	Condition	Water quality	Chlorophyl
		Areal extent of eelgrass beds	% change in eelgrass coverage
		Recruitment and feeding habitat	Composition by juveniles and adults
		Presence of key species	Relative density of black brants

Table 2. Conservation targets, key ecological factors, and indicators of viability for the conservation focus area around Bahia de San Quintin.

Conservation Target	Category	Key Ecological Factor	Indicator
Nearshore coastal zone	Condition	Presence of key species	Presence of red and purple algae, abalone, lobster, sea cucumber, and blue crab
		Primary productivity	Biomass
			Chlorophyl
			Nutrients
Hypersaline lagoon	Condition	Species composition and dominant species	Presence of key avian species
	Size	Areal extent of stromatolite communities	Area covered by stromatolites
Arroyos and riparian vegetation	Landscape context	Hydrologic regime (season, duration, frequency, extent)	Changes in depth to groundwater
	Condition	Faunal composition and structure	Presence of key avian species
		Floral composition and structure	Abundance of key plant species
	Size	Structure of the arroyo	Areal extent of floodplain

Much of the shoreline at Bahía de San Quintín is intact and in good condition, judging from the diversity of species and the height and extent of the dunes, although there has been some disturbance and encroachment as a result of the extraction of beach pebbles and cinders. This activity tramples vegetation and threatens use of the area for nesting and reproduction by shorebirds and other species. The beaches at Bahía de San Quintín support nesting populations of California least terns (*Sterna antillarum browni*) and western snowy plovers. Many narrow and regionally endemic species of plants and various species of clams occupy the different microhabitats associated with the geomorphology of this system.

System of wetlands

Salt marshes and mudflats, which occupy the northern parts of Bahía Falsa and Bahía de San Quintín, are important for the shelter, reproduction, and spawning of fish, crustaceans, and insects and the nesting of migratory and resident birds. These wetlands are characterized by halophytic (salt-tolerant) plants that are sensitive to inundation by the tides and are an important source of detritus and associated nutrients to the system. There are three intertidal zones—the lowest is dominated by *Spartina foliosa*, the intermediate zone is dominated by saltwort (*Batis maritima*) and pickleweed (*Salicornia bigelovii*), and the highest zone is characterized by the presence of species such as *Frankenia grandifolia* and *Monantochloe litoralis*. One of only seven localities of salt marsh bird's beak (*Cordylanthus maritimus maritimus*) in the world occurs at San Quintín (Ibarra-Obando 1990). Associated fauna include important breeding populations of Belding's Savannah sparrow (*Passerculus sandwichensis beldingi*), the only black rails known on the Pacific Coast, and the light-footed clapper rail (*Rallus longirostris levipes*), as well as various species of endemic fish and communities of invertebrates. The population of clapper rails is larger than the total population of this subspecies in all of California (Zembal and Massey 1981)!

The system of wetlands is in good condition, based on the composition of birds feeding there, the abundance of different species of polychaetes (marine worms), the diversity of halophytic plants, including the indicator plant species noted above, and the extent of eelgrass beds.

Coastal scrub

The coastal sage scrub around the bay represents one of the most extensive patches in the State of Baja California and one of the most threatened ecosystems in North America. Moreover, the coastal sage scrub at San Quintín supports one of the highest densities of California gnatcatchers (*Polioptila californica californica*) in Baja California. This vegetation community occurs on three different substrates at San Quintín—sandy dunes, volcanic soils, and silty clays—and consequently with different species, successional states, and structures. Plant species diversity includes halophytic plants, cactus, succulents, deciduous shrubs, and forbs. The coastal scrub at San Quintín supports several endemic species of plants, reptiles, and mammals (Appendix A).

Of the communities at Bahía de San Quintín, coastal scrub has been most impacted by development, agriculture, and recreation, resulting in loss and fragmentation of the habitat and invasion by nonnative plants and animals. Ice plant (*Mesembryanthemum cristallinum*) has

invaded in places where native vegetation has been removed or disturbed, and Argentine ants (*Linepithema humile*), introduced as a result of construction activities, irrigation runoff, nonnative landscaping, and agriculture, are replacing native ant species and disrupting ecological interactions such as predator-prey relationships and seed dispersal. Thus, the proportion of native vs. nonnative species is a good indicator of the health or, conversely, the level of disturbance to the coastal scrub system.

Bays

Bahía Falsa and Bahía de San Quintín are shallow (≤1.8 m) estuarine systems influenced by the tides and connected by deeper channels (≤10 m) to one another and to the Pacific Ocean. Arguably, the most important component of this system of bays is the eelgrass and associated algae, a globally declining resource that is the source of the bay's complex food web. The eelgrass beds support large communities of annelids, polychaetes, amphipods, isopods, small crabs and other crustaceans, mollusks, and tunicates (Leyva-Aguilera 1993). Approximately 30-50% of the black brant population on the west coast of México feeds in this bay system along the Pacific Flyway, as do other migratory waterfowl and shorebirds (Massey and Palacios 1994). The bays serve as key staging areas for fall and spring migrations (Ward et al. 1993), sheltering more than 25,000 migratory shorebirds during the winter (Page et al. 1997). The gray whale also passes through this system and has used Bahía de San Quintín as a reproduction site since the 1970s.

The hydrodynamic condition of the bay system is very good, based on frequent exchange of water, sediments, organisms, and nutrients. An artificial dike built in the northern part of Bahía de San Quintín in the last century has slightly modified the bathymetry, but does not seem to be significantly impacting natural processes. The high water quality and vast extent of the eelgrass beds support good recruitment and feeding habitat, as indicated by the density and diversity of fish and birds present. Any removal or degradation of the eelgrass beds would significantly impact the substrates, productivity, temperatures, and ecological processes of the bay and the biota that depend on these conditions. These impacts would also affect aquaculture, sportfishing, and other economic activities of the local population that depend on the condition of the bays.

Nearshore coastal zone

This community includes the subtidal and intertidal shelf along the Pacific Coast, to a depth of about 20 m, as well as rocky areas along the coastline. The dominant flora of this community are red algae (*Gelidium* and *Gigartina*) and kelp (*Macrocystis*); typical fauna include lobster, abalone, mussels, gastropods, crabs, sea urchins, fish, and sharks, and other commercially desirable species. In general, biomass and primary productivity are high in this zone. An upwelling of the California Current System brings the nutrient-rich waters of this area to the mouth of the bay, and tidal currents distribute these nutrients throughout the bay. This upwelling is the main cause of variability for all physicochemical properties except temperature (Álvarez-Borrego 2004).

Hypersaline lagoon

Laguna Figueroa, north of the San Quintín peninsula, is currently not threatened by development or recreational activities; however, salt mining and the collection of beach pebbles have not been monitored for potential impacts to the lagoon. Laguna Figueroa is separated from the ocean by a chain of coastal dunes that extend south to Volcán Sudoeste. Seawater is filtered through the dunes, and salt flats east of the dunes are used for salt production. There is a narrow band of salt marsh between the dunes and the salt flats. There are other hypersaline basins south of Laguna Figueroa, notably La Pinta Pond, that are also included in this conservation category. These lagoons support nesting of California least terns, western snowy plovers, and Belding's Savannah sparrows, which are listed as Threatened or Endangered in México and the U.S. (Palacios and Alfaro 1991).

This community is notable for its colonies of one-celled, blue-green algae called *stromatolites*—a life form known from the pre-Cambrian era. The salinity of this community limits other species, such as gastropods, that might graze on the stromatolites, and so they grow to form large *carpets* up to 30 cm in diameter. New species of stromatolites have been identified in this area, and calcareous algae (typically rare) is also abundant. There are three hypersaline basins south of San Quintín that contain a unique type of rose-colored gypsum crystals and communities of bacteria and microalgae that can resist prolonged periods of desiccation (Periodico Oficial del Estado de Baja California 2003).

Arroyos and riparian vegetation

The ephemeral arroyos in the focus area—(from north to south) Santo Domingo, La Escopeta, Nueva York, Agua Chiquita, and San Simón—arise in the foothills to the east. Santo Domingo and La Escopeta discharge directly to the ocean; the others discharge to Bahía de San Quintín. Arroyo San Simón is the longest, about 95 km. Riparian vegetation along the arroyos consists of willows (*Salix* sp.), cottonwoods (*Populus fremontii*), ash (*Fraxinus* sp.), sycamore (*Platanus racemosa*), and mesquite (*Prosopis* sp.). The dense vegetation and presence of water attract numerous species of birds, reptiles, amphibians, and mammals. In the last few years, the groundwater level has been low as a result of low rainfall and extraction for agriculture. Changes in depth to groundwater thus provide a good indicator of the health of the system.

The arroyos are an important functional element in the area, providing cover and food for nesting, reproduction, and dispersal of wildlife and transport of water and nutrients. The presence of neotropical song birds is an indication that the composition and structure of these riparian systems are good. However, in some areas the native vegetation has been replaced by tamarisk (*Tamarix* sp.), dumping and burning of trash have degraded the habitat, and sand extraction has changed the geomorphology of the arroyos; these activities, in turn, have adverse impacts on the flora and fauna.

Summary of conservation targets

While each of these conservation targets represents an imperiled resource in remarkably good condition, the complex interdependence of these targets in one geographic location presents an opportune palette for conservation of landscape-level ecological processes that are still functioning the way they have for centuries. It is these intact ecological processes that are crucial to sustaining the economy and beauty of the region.

4 Threats

The single greatest threat to biodiversity at global and regional scales is the loss and fragmentation of habitat into smaller and more isolated blocks that no longer function as a unit (Myers 1997, Brooks et al. 2002). In the area around Bahía de San Quintín, the primary cause of habitat loss and fragmentation is resort and urban development and associated indirect impacts of these activities, followed by expansion of agricultural areas. Essentially all of the conservation targets, with perhaps the exception of the bays and nearshore coastal zone, would suffer irretrievable losses of habitat and/or habitat value as a result of new resort and urban development. Direct loss of habitat will be greatest in the coastal scrub community.

In comparison with these pressures, other sources of habitat loss and degradation have been relatively minor to date, but cumulatively significant (Table 3). While some level of these activities can be compatible with conservation of natural resources at Bahía de San Quintín, incremental growth, coupled with lack of planning, monitoring, and regulation of these activities, will ultimately impact not only the natural resources, but also the human community that relies on these resources for its livelihood.

This section addresses the primary threats to the area around Bahía de San Quintín and the corresponding direct and indirect impacts to the unique and irreplaceable natural resources described in the previous section, assuming that these threats continue unabated for 10 or more years into the future. Because the conservation targets are so interdependent, any impacts to one of the targets will have cascading effects on the others, and thus the cumulative impacts of these threats will be exponentially adverse.

Resort development

There are currently five hotels on the bay, and some of these offer additional services, such as boat ramps, docks, and parking for off-road recreational vehicles. The impacts of these existing facilities are relatively minor and include the generation of trash and runoff, disturbances from small boat traffic, and associated recreational uses. However, large-scale construction of hotels and associated development is proposed for the peninsula, including projects affiliated with the Escalera Naútica, which would construct basic infrastructure along the coasts of the Sea of Cortez and the Pacific Ocean to support recreational boating. Although not part of the Escalera Naútica, *Cabo San Quintín* is a proposed ecotourism development that would include hotels, condominiums, golf courses, tennis courts, and associated facilities. *Playas de la Bahía*, a mobile home park with a dock and canals between the lots, is proposed for the extreme southeastern portion of Bahía de San Quintín, at the mouth of Arroyo San Simón. The locations, size, and impacts of these proposed facilities would not only result in loss, fragmentation, and degradation of habitat, but also create significant indirect impacts on the surrounding resources. Moreover, these developments would destroy the natural beauty and aesthetic values on which tourism depends.

Table 3. Analysis of threats and corresponding impacts to natural resources.

Sources of Impacts	Direct and Indirect Impacts to Natural Resources
Resort and urban development	• Habitat loss • Habitat degradation • Altered hydrologic regime • Groundwater overdraft • Decreased water quality (sedimentation, salinity, nutrient-loading in bay) • Runoff of toxic pollutants to bay • Generation of trash • Introduction of nonnative species • Roadkill • Loss of aesthetic values
Agriculture and livestock	• Habitat loss and fragmentation • Introduction of nonnative species • Increased erosion • Temporary encampments in arroyos • Groundwater overdraft
Tourist recreational activities (including hiking and off-road vehicles)	• Creation of unauthorized trails and roads • Destabilization of dunes and shoreline • Trampling of vegetation and bird nests • Disturbance to nesting shorebirds • Increased erosion • Introduction of nonnative species • Littering and trash dumping • Disturbance from noise and lights • Increased exotic ant species and altered predator-prey relationships • Roadkill
Extraction of beach pebbles and volcanic material (cinders)	• Destabilization of dunes and shoreline • Increased erosion • Disturbance to nesting shorebirds • Loss and fragmentation of coastal scrub • Creation of unauthorized trails and roads
Commercial fishing, small boat traffic, and hunting	• Overexploitation of resources • Disturbance of waterfowl, shorebirds, and marine mammals • Introduction of exotic marine species • Destruction of salt marsh communities • Sewage and pollutants from boats
Aquaculture	• Overexploitation of resources • Disturbance of waterfowl, shorebirds, and marine mammals • Generation of trash • Habitat degradation

Note: additional threats include the development of Puerto Colonet and global climate change. See text.

An example of one of the more tangible development plans is the authorized master-planned subdivision for Monte Ceniza. Proposed by the owner of the majority of the land in the area, this plan includes residential and industrial development, several hotels, restaurants, and a golf course. Although the future implementation of this plan is uncertain, any development on this land would destroy important patches of coastal scrub habitat as well as adversely impact the other conservation targets of Bahía de San Quintín.

Habitat degradation—human-induced changes in the physical, chemical, or biological properties of natural habitats that reduce their ability to support native species and ecological processes.

Indirect impacts of new development are often more insidious and more pervasive than direct impacts. Construction of docks, marinas, roads, and parking lots will not only remove habitat, but will also result in runoff and pollutant loading in the bay (e.g., gasoline, oil and grease, antifouling compounds, human waste). Some of these constituents can be toxic, at very low concentrations, to various life stages of aquatic organisms. For example, antifouling compounds such as tributyl tin are strong bioaccumulators and can be toxic to filter-feeding organisms (e.g., bivalves such as oysters, clams, and mussels) in parts per trillion concentrations (DeMora 1996). Hydrocarbons from spilled fuel, lubricating oil, and discharged bilge water from boats can be toxic to fish eggs and larvae at low parts per billion concentrations.

Eutrophication—caused by an over-accumulation of nutrients, which promotes excessive plant growth and decay and corresponding reductions in water quality.

The addition of nutrients to coastal bays and lagoons can have profound and well-documented adverse effects on the ecology of these systems (Zedler et al. 1992). Elevated nutrient-loading can cause dramatic increases in the abundance of undesirable algal species (Fong et al. 1987), which can decrease transmission of light, negatively affect benthic communities, and reduce dissolved oxygen concentrations, with adverse consequences to aquaculture operations and fisheries in the bay. Eutrophication and siltation have been linked to reductions of eelgrass and other sea grasses worldwide, and alterations to eelgrass distribution and cover can, in turn, directly impact population status and distribution of associated marine organisms, including invertebrates, fish, waterfowl, and marine mammals (Ward et al. 2004). As the extensive eelgrass beds are the basis for much of the biodiversity and the food web at Bahía de San Quintín, this would be devastating to the ecosystem and the economy.

Urban development

Unplanned and unregulated growth of new urban communities to support a growing population will have significant direct impacts on existing natural resources and infrastructure, similar to those impacts described for new resort development. The area is wholly unprepared for this growth. Water is already a scarce commodity on the farms and in the villages throughout Valle de San Quintín, and increased water consumption will be one of the principal problems associated with new urban development. Furthermore, there are no drainage systems or treatment facilities for water and sewage in the area. Sewage effluent not only poses a risk to marine resources but can pose a high human health risk as well. Additional generation of solid waste as a result of increased development will place significant socioeconomic impacts on

existing landfill space, which is currently inadequate, and the inability to control the associated volumes of trash will destroy the scenery, impact wildlife, and pose a high human health risk. These impacts will have serious repercussions on both the economy and the ecology of the region, including both the aquaculture industry and resort industry.

Agriculture and livestock

Habitat fragmentation—the reduction of remnant habitats into smaller and more isolated blocks, each of which may be too small to continue supporting viable populations of species or ecosystem processes that operate over large landscapes, such as fire and hydrological cycles.

Historically, clearing of natural habitats for agriculture (primarily cultivation of tomatoes, strawberries, artichokes, and flowers) and raising livestock has been one of the principal causes for loss and fragmentation of coastal scrub habitat and degradation of adjacent riparian habitat in the arroyos. Agricultural and livestock operations have been accompanied by an increase in abandoned trash and introduction of nonnative invasive plant and animal species, such as ice plant, tamarisk, rodents, and Argentine ants, which compete with native species and disrupt ecological processes. The local farming technique involves covering the fields in winter with strips of plastic; this plastic is then left in the fields and arroyos after its use. Temporary encampments of farm workers in the arroyos have increased erosion and further degraded the riparian community.

Moreover, unsustainable agricultural practices have depleted nutrients from the soil, resulting in the successive abandonment of old agricultural fields and the clearing of new ones. These abandoned, sparsely vegetated fields are subject to wind and water erosion. This cycle of clearing, limited use, abandonment, and finally desertification is expanding across the Valle de San Quintín.

As a result of these practices, Valle de San Quintín suffers from a dramatic overexploitation of the groundwater aquifer, over 60% of the sustainable level, with dramatic underground intrusions of seawater. Additional withdrawals will greatly exacerbate the overdraft of the aquifer and increase the degree of seawater intrusion, thus negatively affecting existing urban and agricultural users, accelerating the decline in water quality, and impeding the possible introduction of industries that have more sustainable water usage. Moreover, the unregulated use of fertilizers and pesticides has contaminated both surface and groundwater supplies. More recently, some farmers have shifted to using greenhouses, where the use of water, fertilizers, and pesticides can potentially be better-controlled and thus more efficient; however, no formal studies have been conducted to evaluate these changes.

Potentially compatible activities

There are many activities that can be compatible with conservation of natural resources at Bahía de San Quintín, if they are monitored to guard against overexploitation of resources. The increase of human intrusion into the area, even without the associated impacts, will add some level of stress to wildlife and wildlife habitats. Public education, accompanied by creation and enforcement of environmental policies, can help ensure that these activities are sustainable.

Tourist recreational activities

People who are attracted to Bahía de San Quintín for its stark splendor and native wildlife will benefit from a better understanding of how even passive recreational activities can disturb the ecosystem they value. Currently, there is no designated trail system for visitors, so random hiking and exploration have the potential to disrupt shorebird nesting, disturb marine life, destroy nests and eggs, trample sensitive plant communities, increase erosion, destabilize dunes, and lead to fragmentation of the natural habitats into smaller patches, divided and isolated by unauthorized trails and roads. Off-road vehicles further exacerbate these impacts with noise and pollutants and could totally destroy these fragile communities. Education, control, and monitoring of visitor use are essential to the effective conservation of natural resources and the viability of the ecotourism industry.

Extraction of beach pebbles and volcanic material

Extraction of beach pebbles, beyond that authorized by permits, can change the structure of the coastline, thereby impacting its buffering functions and potentially disrupting the tidal regime in the bay. The primary beach pebble extraction area extends about 10 km from La Chorera north to and including Ejido Leandro Valle, as well as within Ejido Zarahemla. Extraction of volcanic material primarily impacts the coastal scrub community, resulting in loss and fragmentation of habitat and potential loss of many endemic plants and animal species in the scrub. Access and traffic to and from the resources also directly impact vegetation communities by creating new roads and trails.

Commercial fishing, small boat traffic, and hunting

Fishing, boating, and hunting of waterfowl, particularly the black brant, are major attractions in the San Quintín area. Although there is no accurate quantification of these activities, current numbers of boats and hunters, rates of utilization, and quantities of fish and birds taken are anticipated to have relatively low impacts on the resources. However, the rates are increasing, both for permitted and non-permitted (illegal) activities. Inadequate monitoring and enforcement of regulations for fishing, boating, and hunting could result in the degradation of this area as a critical nursery and refuge for many species and potentially impact future hunting, fishing, and boating activities.

It has been documented that loss of habitat and human disturbance by boat traffic, aircraft traffic, and hunters are largely responsible for population reductions of brants at winter estuarine habitats (Derksen and Ward 1993). Black brants forage on eelgrass most of the day at Bahía de San Quintín to replace fat reserves expended during migration. Disturbances at their winter foraging areas reduce foraging times, potentially impacting their physiological condition for migration and nesting, and may ultimately displace birds from these areas.

These activities also have the potential to disturb nesting shorebirds and marine mammals, introduce exotic marine species, and degrade the fragile salt marsh communities. Sewage and pollutants from commercial and small boat traffic are an associated threat to aquatic organisms, as described above. This directly affects human health and threatens the income of aquaculturists.

Aquaculture

Since 1973, cultivation of Japanese oysters in Bahía Falsa has been the primary focus of aquaculture activities, with approximately 18 aquaculture businesses. In accordance with their certification by the U.S. Food and Drug Administration, regular monitoring of water quality demonstrates that the impact of aquaculture on the bay has been relatively modest to date, as the oysters feed only on plankton brought in by the tides and require no supplemental food, antibiotics, fertilizers, or chemical supplements. In fact, the purity and richness of water at Bahía Falsa and Bahía de San Quintín is found at only a few other locations on the west coast, most notably in British Columbia and Washington State. Therefore, a sustainable economy in the bay is completely dependent on the conservation of its ecosystems. The aquaculture groups are aware that continued, unplanned growth of this industry, accompanied by a growing tourist community, could result in cumulatively significant loss and degradation of habitats in the bay, and they have self-imposed limits to the growth of their facilities.

Other potential stressors in the region

Other activities north and south of San Quintín will have significant adverse impacts on resources in the region, most notably, development of a huge port facility at Punta Colonet, which could change the landscape dramatically as well as increase land values.

Puerto Colonet

A Los Angeles firm is lobbying the Mexican government for permission to build a $1 billion seaport at Punta Colonet. The project would be one of the largest Mexican public works projects ever, with roads, rail lines, port facilities, and associated worker housing and infrastructure, as well as improvements to Highway 1 north to the international border and development of a rail line that would cross the peninsula to the Colorado River basin. Obviously, construction of such a facility would result in the loss of coastal resources in the region, a major population influx, and impacts that will metastasize throughout the peninsula. This development will dramatically change the landscape as well as land values in the region, further reinforcing the need for a comprehensive and sustainable conservation strategy for Bahía de San Quintín.

Proposal to create a new municipality in San Quintín

A committee of local leaders is discussing the formation of a new municipality for San Quintín. A new municipality could have both negative and positive impacts on the future for this area. While the creation of a new municipality could result in greater government investment in public services, and thus improved living conditions for residents, it also could result in population growth and higher demand for urban development. At least some of the representatives on the committee understand that the area's unique biological resources are an asset to the community and that their protection is critical to economic sustainability.

Global climate change

Climate models suggest that, by the beginning of the next century, Southern California and Baja California will experience increased winter precipitation, hotter and drier summers, and more severe El Niño events. These changes could have potentially profound impacts on various sectors of the socioeconomic environment (e.g., land use patterns, energy demand, agriculture,

health) and the natural environment (e.g., vegetation communities, water resources, biodiversity, sea levels). The combined effects of climate change and urbanization on already threatened vegetation communities, such as coastal scrub, could be especially dramatic (Lenihan et al. 2003). One effect of these changes will likely be a general shift in the distribution of vegetation communities and individual species to higher elevations and latitudes (Field et al. 1999). As urbanization continues to fragment landscapes, many individual species and vegetation communities will be unable to shift their distributions in response to changing climate. Thus, plants and animals already stressed by human development will be further stressed by climate change. The availability of broad elevational and other ecological gradients within contiguous habitat areas, such as the landscape between Bahía de San Quintín and Sierra San Pedro Mártir, is critical to accommodate such changes in ecological conditions and species distributions.

Sea-level rise is also widely recognized as a likely consequence of global climate change. Low elevation coastal areas face the risk of inundation and loss. Ideally, such coastal areas would retain an adequate buffer of natural landscapes that would allow for the migration—either natural or facilitated—of coastal habitat inland ahead of the rising waters. Thus, protection of the area surrounding Bahía de San Quintín will create an important buffer between the sea and urban areas, as well as maintain habitat to enhance species viability during periods of climate change.

Resources available to support human communities will also be impacted by these changes. Thus, planners, government officials, businesses, and educators must consider the potential effects of rising sea levels and an uncertain water supply, among other changes, in land use planning, development proposals, conservation strategies, and natural resource education programs.

5 Conservation Strategies

With political changes and increasing foreign investment in the tourism industry in México, conservation organizations, including TNC and its partners, have used diverse strategies for protecting unique and valuable biological resources that, at the same time, recognize the importance of these resources to tourism. This section describes the multiple levels of public and private actions that are being proposed and implemented for conserving resources at Bahía de San Quintín within the context of a sustainable economy and human community in the region.

Throughout history, the natural resources at Bahía de San Quintín have been targeted for protection by many organizations and individuals. Most recently, in 2000, several organizations joined with the local academic community to halt development of a mega resort on the bay. However, these activities have not translated into official protection of the area by the federal, state, or local governments. In 2006, as a result of the draft Conservation Area Plan developed for Bahía San Quintín, four conservation organizations—Terra Peninsular, A.C., Pronatura Noroeste, A.C., Pro Esteros, and TNC—signed a Memorandum of Understanding to form the Coalition for the Protection of Bahía de San Quintín. This unincorporated Coalition will grow to include local economic groups, community leaders, and other institutions which will work toward official and long-term conservation of San Quintín's natural resources. The group's primary strategies for implementing this vision are summarized below.

Public land protection

The Coalition is working to enhance awareness of the benefits of natural resource conservation and to achieve formal protection for Bahía de San Quintín at local, municipal, state, national, and international levels. Historically, protection of natural resources in México has been the responsibility of the federal government, which established the Sistema Nacional de Áreas Naturales Protegidas (Natural Protected Areas System) to achieve this conservation objective. These parks or protected areas are protected by a Presidential Decree, establishing use restrictions on the property but without changing land tenure. Incentives, land management guidelines, and enforcement funds are all needed to supplement a federal designation or any other local, municipal, state, or international designation. The Coalition is also implementing innovative strategies such as requesting concessions, for protection purposes, of the Federal Maritime Zone (ZOFEMAT—a portion of land above the beach owned by the government); if successful, this tool would be a breakthrough in public land conservation and it could prevent development of adjacent coastal lands. Progress made to date by the Coalition includes:

- Completed second version of Justification Study to create a Natural Protected Area at Bahía de San Quintín
- Presented Ramsar designation proposal to Mexican authorities (designation expected by the end of 2007)
- Applied to get concession of about 24 ha of ZOFEMAT adjacent to priority wetlands in Bahía de San Quintín

Abating and mitigating threats to natural resources

There are opportunities for working with the tourism industry, aquaculture, and fishing and hunting promoters at Bahía de San Quintín. These economic groups participated in TNC's Conservation Area Plan process to develop strategies for abating and mitigating threats to natural resources. TNC will continue working with these groups and the appropriate agencies to facilitate the implementation of these strategies, which include, among others:

- Organizing service industry and other economic activities to be better regulated and to decrease their impacts on natural resources
- Improving law enforcement and monitoring of extraction or consumption limits (e.g., mining of beach pebbles and sand, limits on fishing and hunting)

In addition, Pro Esteros and Pronatura Noroeste are working with elementary and junior high schools in the area to develop environmental education programs that emphasize the importance of the bay and its natural resources to maintaining a sustainable community.

Private land conservation

Private nonprofit organizations have taken a leadership role in working with landowners and businesses to promote habitat conservation by purchasing privately-owned and *ejido* lands (urban plots, individual parcels, and communally worked lands) for conservation and utilizing other legal conservation tools that allow landowners to voluntarily restrict the type and amount of development. TNC and its partners are exploring several of these mechanisms to protect Bahía de San Quintín; some of these are described below.

Land purchase

Nonprofit conservation organizations incorporated under Mexican law may purchase and own land in the Bahía de San Quintín area. There are very few parcels in the area (Figure 5), and acquiring these parcels for permanent protection could have an immediate effect by influencing other land use decisions and potentially leveraging other conservation tools. Purchasing a strategic property for conservation, such as the 891-ha peninsula which supports wetlands, sand dunes, volcanic cones, and coastal scrub habitats, would have an enormous visual impact on the future of the region and set an example of the available options for other landowners. Conservation of Punta Azufre, Monte Cenizo, and Volcan Sudoeste properties (approximately 1,266 ha) would have similar impacts by establishing the framework for a new future in the region. All of these properties are critical to protection of the bay and its most sensitive resources, and their conservation would provide the greatest return on investment.

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Figure 5 - Tracts

Usufructo contracts

An *usufructo* is a temporary right that a landowner gives to a third party for a stipulated time to use or benefit from the resources on a property for certain purposes (in this case, conservation). An *usufructo* is similar to a lease in that the landowner retains all other property rights, including the right to use the land after the expiration of the *usufructo*, sell, donate, or pass on the land to heirs (Gutiérrez Lacayo et al. 2002). For nonprofit conservation organizations, an *usufructo* may last up to 20 or 30 years.

Conservation easements

The *servidumbre ecológica* (conservation easement) is a voluntary legal agreement between two or more property owners to permanently limit the development rights of the servient property to the benefit of the dominant estate. This agreement is put into place on the landowner's property for conservation purposes, including the preservation of natural resources, scenic beauty, and historical and cultural values of the land. Among other potential restrictions, conservation easements typically restrict the type or intensity of land use allowed on the property and the cutting or clearing of vegetation. Many of these restrictions may also benefit ecotourism in Bahía de San Quintín, which depends on the conservation of threatened or unique ecosystems.

Combination of strategies

The Coalition, including TNC, plans to utilize a combination of strategies and tools to create the greatest possible level of protection for Bahía de San Quintín. It is essential, in this landscape, that a realistic combination of public protection and private land conservation be established that also enjoys public participation and support. It is only with community support and benefit that conservation successes will be sustainable at Bahía de San Quintín.

6 Commitment to an alternate future: sustainable ecosystem management

The Conservation Area Plan compiled by TNC and Terra Peninsular establishes the framework for a sustainable economy and quality of life in the region. With the support of the local community, municipio, state, and federal governments, and with an infusion of conservation initiatives catalyzed by the members of the Coalition, the vision presented in the plan can be realized within the next decade.

What does this future look like for San Quintín?

- New community paradigm. First and foremost, there will be a change in attitude of the local population, fostered through public outreach and environmental education at all levels of society—local schools, businesses, government, and health services. The local community will take pride in its natural resources and recognize that conserved lands can provide environmental services, benefit economic development, and help to sustain human and ecological communities. The academic community and civic organizations will partner with local government in effecting this shift in paradigms.
- Infrastructure improvements. Local government programs will be established for improving infrastructure for water use, water treatment, and disposal, as well as for handling of trash and recyclables.
- Increased capacity for tourism. Federal, state, and local governments will work together with local hotels, restaurants, and other tourism services businesses to train staff and build services dedicated to tourism activities. Tourist cooperatives will work together to monitor and enforce environmental regulations for discharge of wastes from boats, use of off-road recreational vehicles, and other recreational activites in sensitive areas. Guided tours will be offered to prevent uncontrolled access to sensitive resources.
- Planned urban development. New development to support the needs of the local community in the region will occur in designated zones and will be phased according to the level of infrastructure and groundwater resources available at the time.
- Agriculture and livestock. Unused and abandoned agricultural fields will be converted to cultivation practices that use water more efficiently, e.g., greenhouses, use of local species, new alternatives for cultivating arid lands. Infrastructure will be installed to capture rainfall water, avoid runoff, and allow aquifer recharge. Regulations will be in place for land use, ownership, and leasing of land, specifically to control clearing of land and the use and disposal of plastic sheets used in agricultural fields. New incentives will enable these changes.
- Extraction. New partnerships and new regulations will be established to avoid excessive impacts to the integrity of the shoreline. These partnerships will create a database with numbers of permit-holders, volume of sand extracted, and geographic areas of extraction. The terms of the permits will be monitored so that extraction activities are carried out responsibly.

- Aquaculture. Aquaculture producers will continue instituting self-monitoring procedures, such as limits to their operational growth. They will work with different levels of government that support aquaculture (e.g., Alianza para el Campo, Desarrollo Social) to establish relationships with banks and investors. They will cover regional demand and increase the number of producers that export quality products.
- New horizon. A commitment to maintain the current landscape, with all the power, energy, and richness that it represents, will instill a sense of confidance, unity, and certainty in the future for the local community, without the threats of outside development that could cause upheaval in their lives. Creation of new partnerships will solidify the community around the stewardship of this landscape.
- An iconic and lasting landscape. The inspiration for these changes will be the legacy, biodiversity, productivity, and beauty of Bahía de San Quintín. The dramatic landscape and its dynamic ecological processes will continue intact, and the energy that originally gave birth to the volcanoes and the chain of sand dunes will persist in the upwelling of the California Current, in the complex food webs of the vast eelgrass beds, and in the remarkable journey of the black brant. This ancient reminder of the historic continental coastline will be *effectively* conserved by the human community that itself depends on the landscape's resources for persistence.

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Appendix A

Species known to occur or with the potential to occur at Bahía de San Quintín that are narrowly endemic, protected under Mexican or U.S. endangered species law, or have significant populations at Bahía de San Quintín

Scientific Name	Common Name	Legal/Population Status
Fish		
Paraclinus walkeri	San Quintín blenny	Endemic
Amphibians		
Aneides lugubris	Arboreal salamander	Rare
Ensatina eschscholtzii	Ensatina	Rare
Reptiles		
Aniella geronimensis	Baja California legless lizard	Rare/endemic
Aniella pulchra	California legless lizard	Rare
Callisaurus draconoides	Zebra-tailed lizard	Threatened
Cnemidophorus hyperythrus beldingi	Orange-throated whiptail	Threatened
Cnemidophorus labialis	Baja California whiptail	Rare/endemic
Coleonix variegatus	Banded gecko	Rare
Crotalus enyo furvus	Dusky Baja California rattlesnake	Threatened/endemic
Elgaria (Gerrhonotus) multicarinata	Southern alligator lizard	Rare
Eumeces gilberti	Gilbert's skink	Rare
Gambelia wislienii	Long-nosed leopard lizard	Rare
Masticophis flagellum	Coachwhip	Threatened
Phrynosoma coronatum	Coast horned lizard	Threatened
Phyllodactylus xanti	Leaf-toed gecko	Rare
Urosaurus nigricaudus	Black-tailed brush lizard	Threatened/endemic
Birds		
Accipiter cooperii	Cooper's hawk	Threatened
Anas acuta	Northern pintail	Special protection
Anas discors	Blue-winged teal	Special protection
Anser albifrons elgansi	Greater white-fronted goose	Endangered
Aquila chrysaetos	Golden eagle	Endangered
Asio flammeus	Short-eared owl	Threatened
Athene cunicularia	Burrowing owl	Threatened
Aythya affinis	Lesser scaup	Special protection
Branta bernicla nigricans	Black brant	30-50% of Mexican population winters at San Quintín
Branta canadensis leucopareia	Canada goose	Special protection
Buteo jamaicensis	Red-tailed hawk	Special protection
Campylorhynchus brunneicapillus couesi	Coastal cactus wren	Significant population at SQ
Charadrius montanus	Mountain plover	Threatened

Scientific Name	Common Name	Legal/Population Status
Charadrius alexandrinus nivosus	Western snowy plover	Threatened (U.S.)
Circus cyaneus	Northern harrier	Threatened
Egretta rufescens	Reddish egret	Threatened
Falco columbarius	Merlin	Threatened
Falco peregrinus	Peregrine falcon	Threatened
Larus heermani	Heermann's gull	Threatened
Laterallus jamaicensis	Black rail	Rare
Passerculus sandwichensis beldingi	Belding's Savannah sparrow	Threatened
Polioptila californica atwoodi	California gnatcatcher	High density population at SQ
Rallus longirostris levipes	Light-footed clapper rail	Endangered/endemic; SQ pop. larger than entire CA pop.
Sterna antillarum browni	California least tern	Endangered
Sterna elegans	Elegant tern	Threatened
Mammals		
Chaetodipus arenarius helleri	San Quintín sand pocket mouse	Endemic
Dipodomys gravipes	San Quintín kangaroo rat	Endangered/endemic; likely extirpated
Dipodomys merriami quintinensis	Merriam's kangaroo rat	Threatened/endemic
Neotoma lepida egressa	El Rosario white-footed woodrat	Endemic
Neotoma martinensis	San Martín Island wood rat	Endemic to Isla San Martín
Microtus californicus aequivocus	San Quintín meadow mouse	Endangered/endemic
Peromyscus maniculatus exigus	Deer mouse	Endemic to Isla San Martín
Phoca vitulina	Harbor seal	Special Protection
Reithrodontomys megalotis peninsulae	Harvest mouse	Endemic
Sorex ornatus ornatus	Ornate shrew	Rare/endemic
Sylvilagus bachmanii rosaphagus	Brush rabbit	Rare/endemic
Zalophus californianus	California sea lion	Special Protection
Plants		
Amsinckia inepta	Fiddleneck	Endemic to San Quintín
Arctostaphylos australis	Manzanita	Endemic just north of SQ region
Astragalus anemophilus	San Quintín astragalus	Endemic to San Quintín
Astragalus harbisonii	El Rosario astragalus	Endemic to San Quintín region
Astragalus oxyphysopsis	Locoweed	Endemic
Berberis claireae	Barberry	Endemic to San Quintín region
Camissonia proavita	San Vicente camissonia	Endemic to San Quintín region
Centromadia perennis	Colonet tarplant	Endemic to San Quintín region
Chaenactis furcata	Pincushion	Endemic
Chorizanthe chaetophora	Spineflower	Endemic
Chorizanthe jonesiana	San Quintín chorizanthe	Endemic to San Quintín region
Chorizanthe interposita	Chorizanthe	Endemic to San Quintín region

Scientific Name	Common Name	Legal/Population Status
Chorizanthe turbinata	El Rosario chorizanthe	Endemic to San Quintín region
Cordylanthus maritimus ssp. *maritimus*	Salt marsh bird's beak	Endangered (U.S.)
Cylindropuntia alcahes var. *nov.*	Cholla	Undescribed variety endemic to San Quintín region
Cylindropuntia rosarica	Cholla	Endemic to San Quintín region
Dudleya anthonyi	San Martín dudleya	Endemic to Isla San Martín
Echinocereus maritimus var. *maritimus*	Maritime hedgehog cactus	Endemic
Eriogonum fastigiatum	Buckwheat	Endemic to San Quintín region
Eriogonum scalare	El Rosario buckwheat	Endemic to San Quintín region
Eryngium sp. *nov.*	San Quintín eryngium	Endemic to San Quintín
Ferocactus fordii var. *fordii*	Ford's barrel cactus	Endemic
Fraxinus parryi	Ash	Endemic to TJ to SQ and 1 individual in US
Haplopappus venetus	Haplopappus	Endemic
Harfordia macroptera var. *golioides*	Rabbit's purse	Endemic
Hazardi berberidis	Hazardia	Endemic
Hazardia ferrisiae	Hazardia	Endemic to San Quintín region
Hazardia rosarica	El Rosario hazardia	Endemic to San Quintín region
Leptosiphon laxus		Endemic
Lotus cedrosensis	Lotus	Endemic
Lotus distichus	Lotus	Endemic
Mammillaria louisae	Mammillaria	Endemic
Oenothera wigginsii	San Quintín oenothera	Endemic to San Quintín
Orcuttia californica	California orcutt grass	Endangered (U.S.)
Phacelia hirtuosa	San Quintín phacelia	Endemic to San Quintín
Ptelea aptera		Endemic from Ensenada to SQ
Ribes tortuosum	Currant	Endemic
Sibara brandegeana		Endemic
Sphaeralcea fulva	Sphaeralcea	Endemic

Source: NOM-059ECOL, Aguirre et al. 1999, Salazar unpubl. data 2000, Rebman pers.comm; Mellink pers. comm.; Tremor pers. comm.