8.0 LOSS OF CONNECTIVITY

8.1 OVERVIEW

Connectivity refers to the degree to which the landscape facilitates or impedes movement of genes, individuals, propagules or populations among resource patches (Taylor et al. 1993; Hilty et al. 2006). Maintaining connectivity between natural areas is widely regarded as essential to maintaining functional landscapes and evolutionary processes (e.g., Noss 1987, 1991; Saunders et al. 1991; Beier and Noss 1998). Connectivity is also viewed as essential to promoting dispersal among habitat patches; maintaining gene flow; facilitating local adaptation; and promoting resilience to many threats, including fire, floods, disease, and climate change (Austin et al. 2004; Anacker et al. 2013).

There are 2 types of connectivity: *structural* and *functional*. *Structural connectivity* refers to the physical relationship between landscape elements, whereas *functional connectivity* describes the degree to which landscapes actually facilitate or impede the movement of organisms and processes (Meiklejohn et al. 2010). Functional connectivity is a product of both landscape structure and the response of organisms and processes to this structure. Thus, functional connectivity is both species and landscape specific. Distinguishing between these 2 types of connectivity is important because structural connectivity does not imply functional connectivity. Protecting and restoring functional connectivity is the goal of the MSP Roadmap.

The loss of connectivity is a major driver in the loss of biodiversity across southern California, including the MSPA. Within the MSPA, roads and urban development have created barriers to species movement, especially for wide-ranging species that need large patches of land. Roads, in particular, fragment habitat and create barriers that impede mobility and result in increased wildlife mortality. In addition, large wildfires in the last 20 years have resulted in loss of habitat and reduced connectivity for some species such as the coastal cactus wren and Hermes copper butterfly. Fragmentation by anthropogenic or natural disturbances can result in genetic isolation, putting some species at risk over the longer term (Trombulak and Frisell 2000; Van der Ree et al. 2011). As habitat becomes fragmented, populations or subpopulations may become separated or even isolated in the remaining smaller habitat patches. Smaller populations are at greater risk of extirpation due to stochastic and anthropogenic events.

The MSCP, MHCP, and future North County NCCP Plans identify blocks of Conserved Lands connected by linkages (Figure V2B.8-1) that are intended to maintain natural processes (e.g., erosion and sediment deposition, organic litter accumulation, etc.) and movement of species between NCCP conserved areas and to Conserved Lands outside of the plan areas. Maintaining connectivity within and among core habitat areas through conservation and management of land is essential for maintaining the biodiversity of the preserve system and ensuring resilience of species and natural communities in the San Diego region and beyond. Connectivity monitoring is a required element of these plans to confirm that linkages are functionally connecting core habitat areas. Monitoring will also aid in the identification of actions to improve or restore connectivity between Conserved Lands.

8.2 CONNECTIVITY IN THE MSPA

Although large blocks of habitat have been conserved in the MSPA, the preserve system in western San Diego County is still being assembled and gaps of unprotected habitat remain between existing Conserved Lands that, if developed, will result in the permanent fragmentation of core and linkage areas. In addition, major highways and arterial roads bisect Conserved Lands and create impediments to wildlife movement. In other areas, habitat degradation caused by invasive plants or altered fire regimes has led to the fragmentation of otherwise connected habitat patches for rare species. On the coast, urban development and roads surround Conserved Lands leaving narrow drainages that connect these otherwise isolated habitat patches. Prioritizing management and monitoring actions for securing connectivity between these assembled Conserved Lands considers the following: (1) maintaining and protecting permeability between Conserved Lands; (2) preventing choke points from becoming severed; and (3) restoring connectivity through habitat restoration or infrastructure improvements.

8.2.1 Core Habitat Areas in the MSPA

Figure V2B.8-2 shows the Cores and Linkages identified by the MSCP and the MHCP for the plan areas in 1997 and 2003, respectively. The Core and Linkage maps were prepared as analytical tools to assist with assessing preserve design criteria and levels of species conservation (Ogden Environmental and Energy Services Co. 1996; AMEC Earth & Environmental, Inc. et al. 2003). In 2011, the Connectivity Monitoring Strategic Plan (CMSP; SDMMP 2011) included updated Core and Linkage areas as shown in Figure V2B.8-3 to assist with prioritizing management and monitoring actions (see 2011 CMSP for rationale; SDMMP 2011).

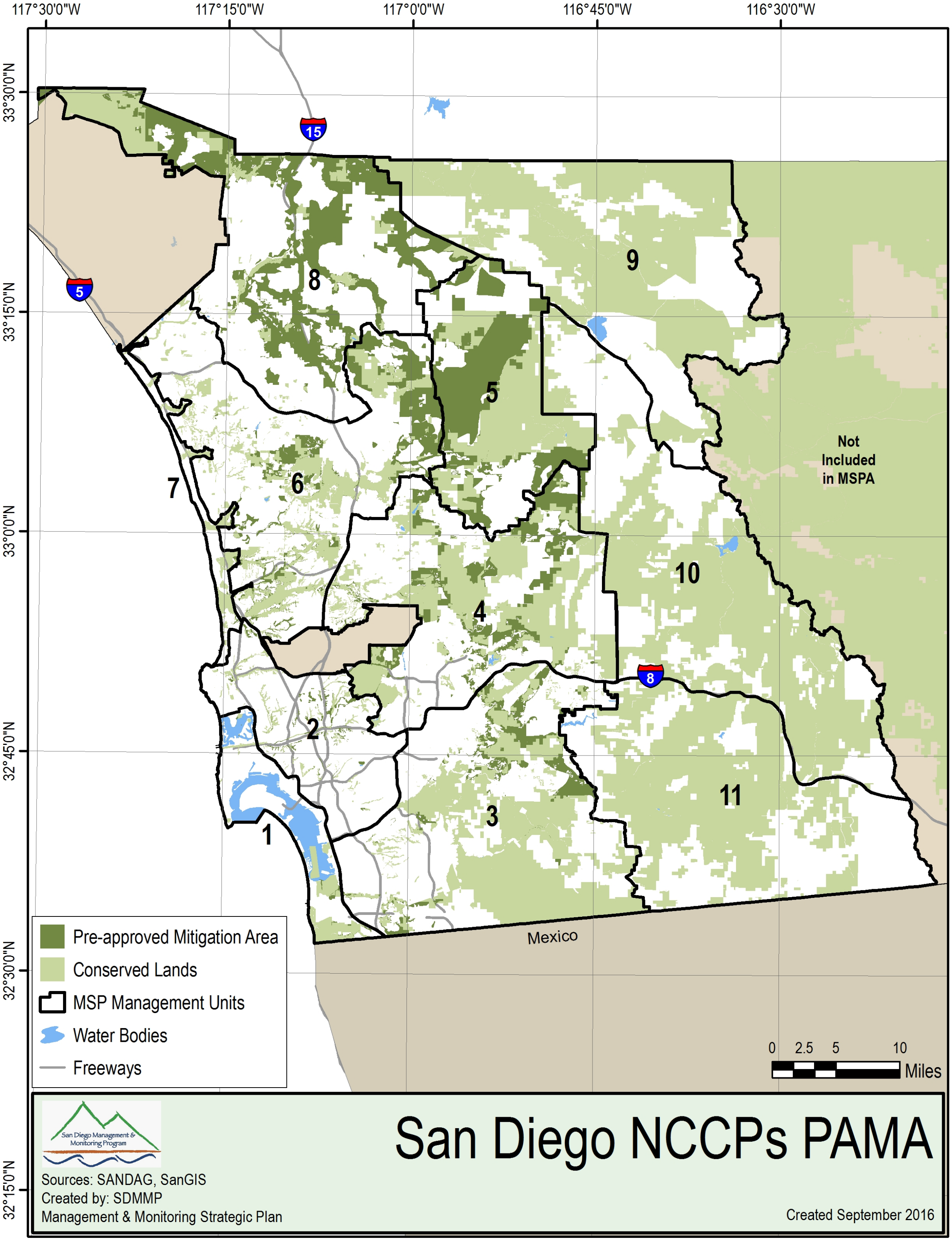

Figure V2B.8-1. Pre-approved Mitigation Areas from the MSCP, MHCP, and future North County NCCP.

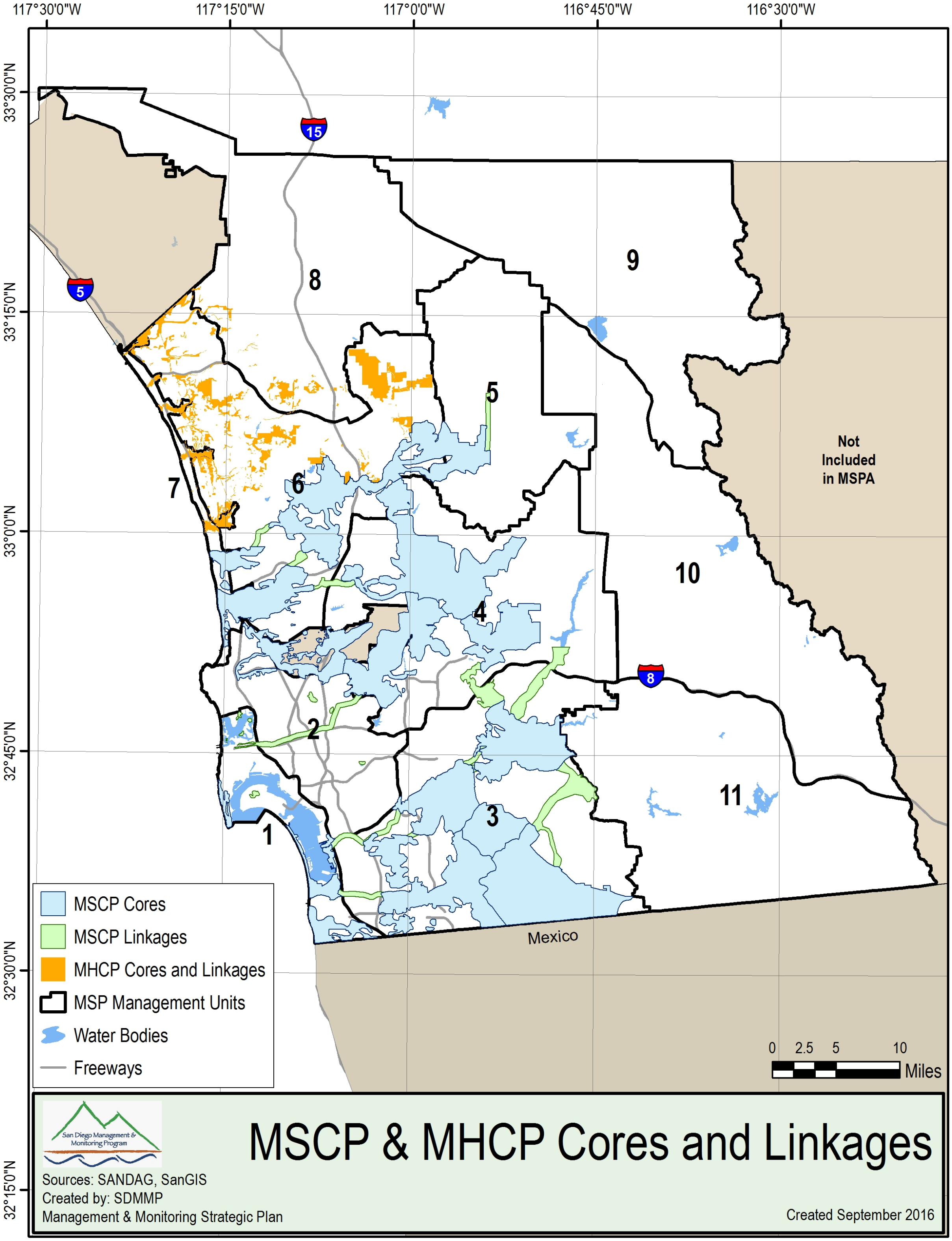

Figure V2B.8-2. MSCP and MHCP Cores and Linkages.

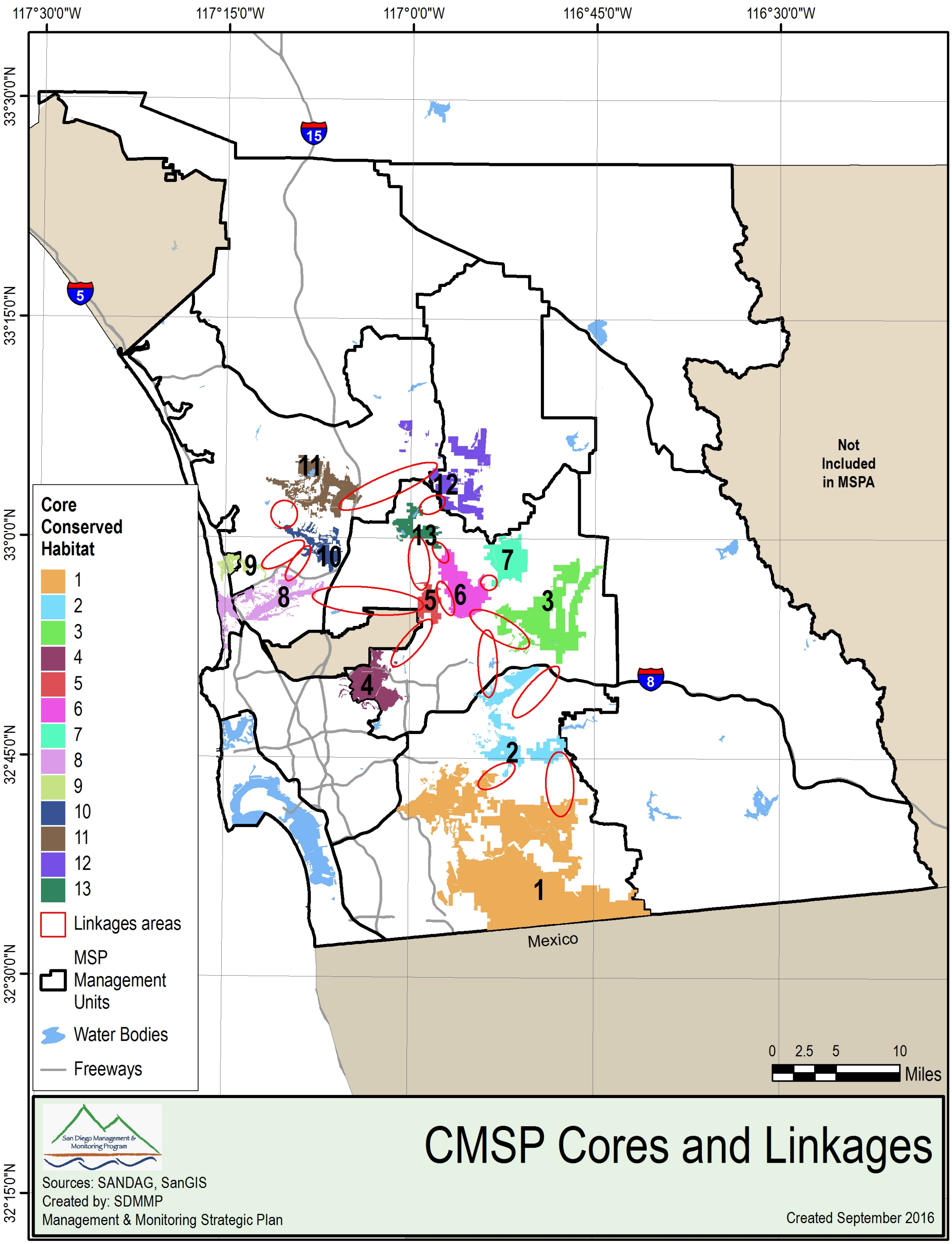

Figure V2B.8-3. CMSP Cores and Linkages.

Because the planning area for the MSPA is much larger than the MSCP and MHCP areas and has been expanded to the east with the MSP update, the approach for identifying cores has been modified to consider the broader landscape context of western San Diego County and adjacent planning areas. For the MSP Roadmap, a Core Habitat Area (also referred to as "Core" or "Core Area") is defined as a contiguous area of relatively intact natural vegetative cover that is at least 1,250 acres in size and with little or no permanent internal fragmentation from human development. In some cases, Core Habitat Areas smaller than 1,250 acres have been included where valuable biological resources exist in localized areas (e.g., lagoons, vernal pools, cactus habitat). In addition to Conserved Lands, Core Habitat Areas may include un-conserved but intact habitat on private lands, military lands, utility lands (e.g., water districts), and tribal lands.

Core Habitat Areas provide many values toward protecting native species and the integrity of natural systems. These values include (Austin et al. 2004): supporting natural ecological processes such as predator-prey interactions and natural disturbance regimes; helping to maintain air and water quality; supporting the biological requirements of many plant and animal species, especially those that require large areas to survive; supporting viable populations of wide-ranging animals by allowing access to important feeding habitat, reproduction, and genetic exchange; and serving as habitat for source populations of dispersing animals for recolonization of nearby habitats that may have lost their original populations.
A total of 27 Core Habitat Areas (labeled A through Z, plus AA) were identified in the MSPA based on the above criteria (Table V2.8-1). Conserved lands within Core Habitat Areas are shown in Figure V2B.8-4 (or view online at: http://arcg.is/2iSQHRJ), which provides an overview of how well Conserved Lands are currently connected and where there are gaps of unprotected habitat between existing Conserved Lands.

Within the broader MSPA, Core Habitat Areas range in size from 1,104 acres to 272,142 acres. The average Core Habitat Area is 49,867 acres. West of I-15, Core Habitat Areas are smaller and largely defined by intense urban development, whereas, in the inland area, Core Habitat Areas tend to be much larger and are usually defined by major highways such as I-8 and State Route (SR) 52, SR 67, SR 76, SR 78 and SR 79.

In terms of level of conservation in each core, the cores with the largest acreage of conserved intact habitat are found in Core C (Eastern Mountain Boundary) followed by Core V (Crestridge-Hollenbeck-McGinty), M (San Vicente/Iron

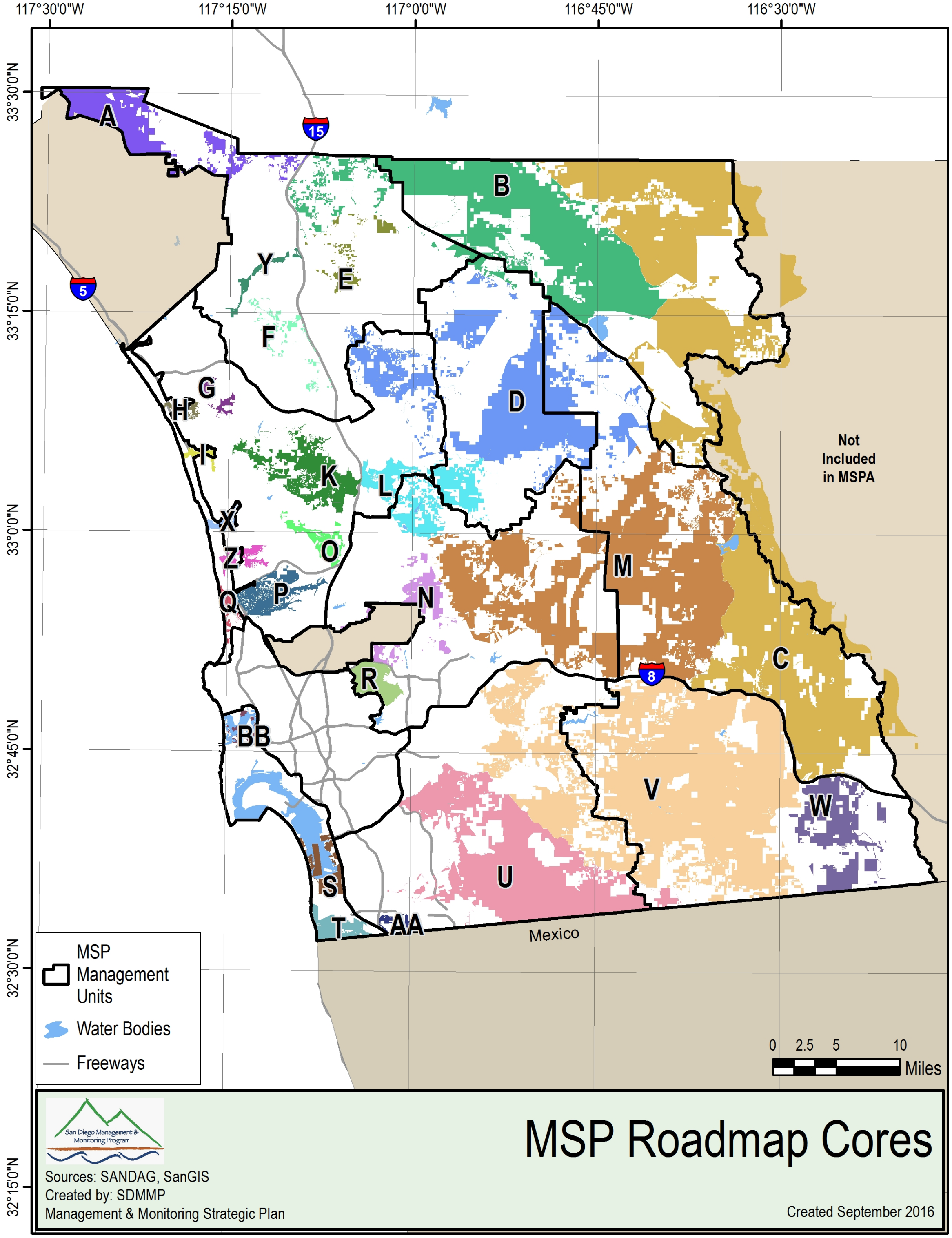

Figure V2B.8-4. MSP Roadmap Conserved Lands in Core Areas.

Table V2B.8-1. Summary of Core Habitat Areas

Core ID	MSPA Core Name	MU(s)	MSCP Core Area ID	Total Core Acres	Total Acres Conserved	Percent Conserved	Total Acres Urban	Percent Urban
A	Santa Ana Mountains	8	N/A	150,020	16,014	11	2,324	2
B	Palomar Mountains	9	N/A	132,152	67,464	51	9,307	7
C	Eastern Mountain Boundary	9,10	N/A	272,142	180,945	66	11,024	4
D	Daley Ranch-Pauma Valley	4	N/A	146,260	51,072	35	12,211	8
E	Lilac Ranch	4	N/A	17,094	1,709	10	1,274	7
F	Merriam Mountain	6	N/A	9,569	718	8	1,549	16
G	Carlsbad Cores 3/5	6	N/A	2,482	1,485	60	114	5
H	Carlsbad 4	6	N/A	1,400	981	70	183	13
I	Carlsbad 8	6	N/A	1,411	928	66	158	11
J	Mission Bay	1	Mission Bay	3,104	137	4	403	13
K	Lake Hodges	6	Lake Hodges / San Pasqual Valley	18,899	10,828	57	2,806	15
L	Ramona/Mt Woodsen	4	Central Poway	27,053	10,793	40	5,714	21
M	San Vicente/Iron Mountain	5	Central Poway/San Vicente, Lake Jennings/Wildcat Canyon/-El Cajon Mountain	177,871	98,258	55	17,120	10
N	Gooden Ranch/Sycamore Cyn	5	Mission Trails/Kearny Mesa/ East Elliot/Santee	29,106	6,122	21	1,107	4
O	Black Mountain	6	Lake Hodges/San Pasqual Valley	4,269	3,075	72	290	7
P	Peñasquitos Canyon	6	Peñasquitos Lagoon, Del Mar Mesa, Peñasquitos Canyon	8,534	5,235	61	1,998	23
Q	Torrey Pines	7	Peñasquitos Lagoon, Del Mar Mesa, Peñasquitos Canyon	2,241	1,596	71	225	10
R	Mission Trails	5	Mission Trails/ Kearny Mesa/East Elliot, Santee	5,370	5,150	96	127	2
S	Silver Strand	2	Silver Strand	8,014	2,710	34	2,342	29
T	Tijuana Estuary	2	Tijuana Estuary	4,791	3,827	80	262	5

Core ID	MSPA Core Name	MU(s)	MSCP Core Area ID	Total Core Acres	Total Acres Conserved	Percent Conserved	Total Acres Urban	Percent Urban
U	Greater SDNWR	3,4	Sweetwater River/ San Miguel Mountain/Sweetwater Reservoir, Marron Valley/Otay Mountain	81,354	56,810	70	4,134	5
V	Crestridge-Hollenbeck-McGinty	3	McGinty Mtn/Sequan Peak-Dehesa	203,912	123,549	61	27,065	13
W	Campo	11	N/A	3,104	137	4	403	13
X	San Elijo Lagoon	8	San Dieguito Lagoon	1,104	955	87	136	12
Y	San Luis Rey River	6. 8	N/A	3,388	1,509	45	398	12
Z	San Dieguito Lagoon	7/6	San Dieguito Lagoon	2,247	2,144	95	205	9
AA	Spring Canyon/Furby North	2	Spring Canyon	2,298	606	26	165	7

Mountain), and B (Palomar Mountain). In terms of percent area conserved, the cores with the lowest percent conserved (in terms of total acreage of unprotected private lands) are Cores C, D, B, M and V. While Cores M and V support large areas of Conserved Lands, these cores are also on the verge of being fragmented into smaller cores as a result of expanding agricultural and urban development. Connectivity monitoring will help assess whether there remain opportunities for maintaining connectivity within these cores and will assist with prioritizing actions, such as land acquisition, to ensure that smaller habitat patches remain connected to larger Core Habitat Areas.

8.2.2 Linkages in the MSPA

A linkage is defined as connected land intended to promote movement of multiple focal species or propagation of ecosystem processes (Beier et al. 2008). Linkages within the MSPA include both *Between*-Core and *Within*-Core linkages. In Figure V2B.8-5 (or view online at: http://arcg.is/2iSQHRJ), Between-Core linkages are assigned letters according to the Core Habitat Areas they are connecting (i.e., A–B, D–E, etc.). Within-Core linkages are identified by the assigned Core letter and a number (i.e., A1, A2, etc.).

In the MSPA, Within-Core linkages are important for maintaining connectivity between habitat patches for species that can persist in smaller habitat fragments, whereas both Within- and Between-Core linkages are important for wide-ranging species that have ranges that extend beyond an individual Core Habitat Area. Mountain lions, for example, occupy ranges that encompass up to 300 square kilometers and disperse distances that average 65 kilometers (much larger than any single core area) and requiring movement between cores to persist in the MSPA.

West of I-15, Core Habitat Areas tend to be smaller and surrounded by roads and development. Linkages west of I-15 are largely Between-Core linkages and often consist of narrow canyons and drainages. A few of these linkages connect coastal lagoons with more inland areas along drainages. These linkages are vital to maintaining lagoon processes and for providing opportunities for species to move with climate change and sea level rise. East of I-15, many linkages are not well defined, and will require further refinement through the linkage evaluation and design process. Linkages east of I-15 often involve crossings of major highways, including SR 67, SR 76, SR 78, SR 79, and SR 94. While most of these are 2-lane highways where they intersect Conserved Lands, they support high traffic volumes

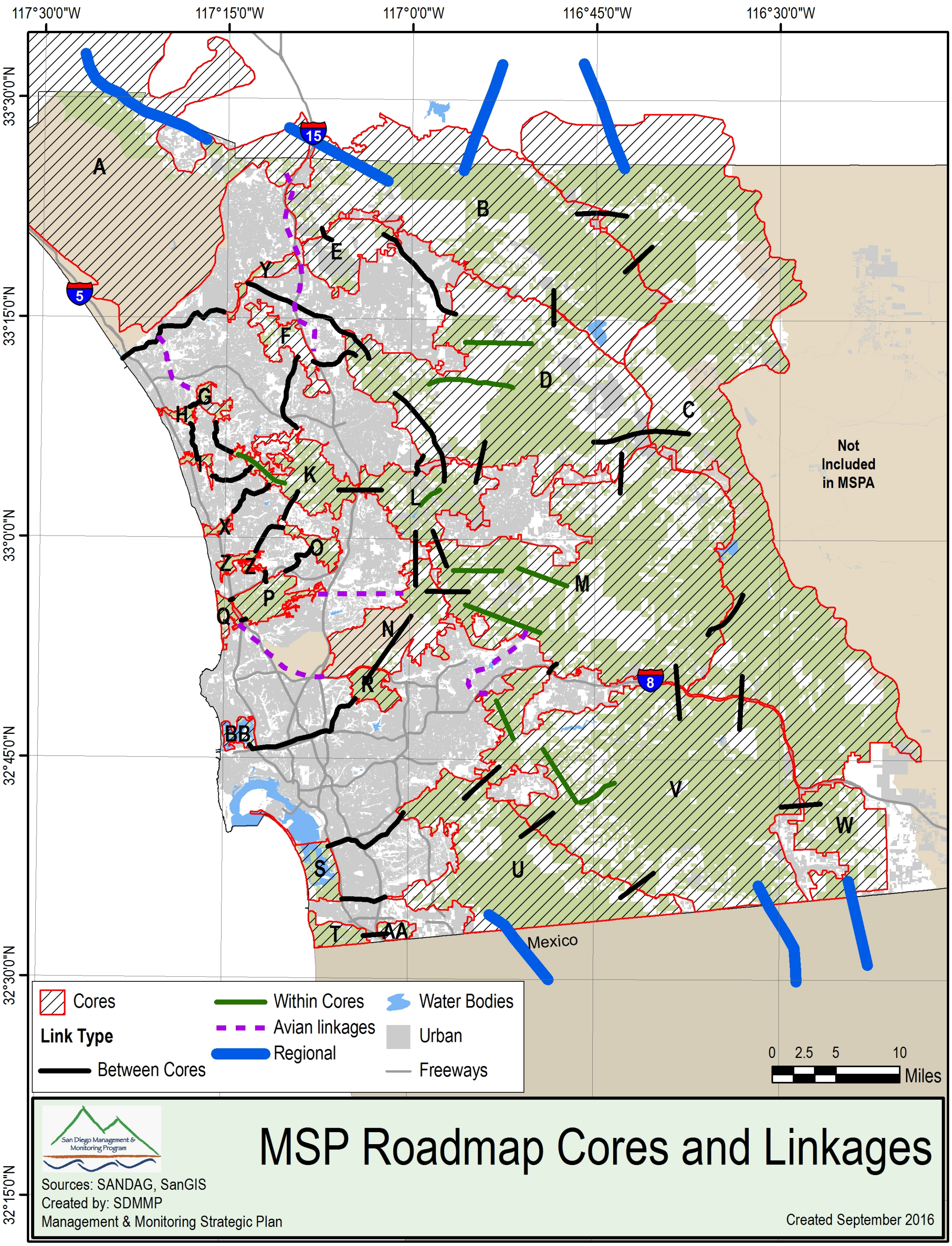

Figure V2B.8-5. MSP Roadmap Between-Core and Within-Core Linkages.

that are expected to rise with increased development in the backcountry. These highways, known for their curves, hill climbs, and narrow line of sight, do not support adequate wildlife crossing structures, both inhibiting wildlife movement and forcing wildlife to cross at-grade (CBI 2015). In anticipation of future highway widening plans, wildlife infrastructure improvement plans have been prepared for SR 94 and are being prepared for SR 67. These plans, informed by wildlife monitoring studies, are being developed to assist with identifying spatially explicit linkages that inform land protection needs and the placement and design of wildlife crossing structures and directional fencing to increase the permeability of these roads for a suite of wildlife species.

Within-Core linkages east of I-15 consist of gaps of unprotected lands between conserved habitat and crossings of busy arterial roads. Gaps in unprotected habitat between Conserved Lands in the southern part of the MSPA are narrowing as a result of urban and rural development and require attention in the next 5 years to ensure that connectivity is maintained. For example, linkages between Sycuan Peak Ecological Reserve (ER), Hollenbeck Canyon ER, and Crestridge ER are increasingly becoming constrained by urban development, and opportunities for maintaining these connections are becoming scarce. Elsewhere, arterial roads such as Barona Road, Wildcat Canyon Road, and Valley Center Road, serve to decrease internal permeability of Core Habitat Areas, as many do not support adequate wildlife crossing infrastructure. Finding the best locations for, as well as solutions to protect, these linkages in the next 5 years is critical, and will require a combination of restoration, land acquisition, and wildlife crossing infrastructure where these choke points involve major roadways.

8.3 RESULTS OF CONNECTIVITY STUDIES IN THE MSPA

Existing identified linkages within the NCCP areas have been monitored for their effectiveness through various early studies (CBI 2002, 2003a and b, 2004; Webb and Campbell 2003). These efforts focused on monitoring the use of identified habitat linkages and choke points by large mammals, primarily deer, bobcats, coyotes, and mountain lions. These studies identified wildlife use of linkages, compared monitoring methods (e.g., cameras, track stations, scent stations) and recommended locations (existing and new) for future monitoring.

Following these studies, the 2011 CMSP included priority objectives for the implementation of several additional connectivity studies for 3 functional groups: large animals (mountain lion, bobcat, badger, and deer), small animals (various), and birds (coastal California gnatcatcher and coastal cactus wren) plus an evaluation of linkages (corridors and choke points) for potential functionality.

While previous studies confirmed the use of linkages and choke points by target species, they did not examine genetic exchange which is necessary for long-term population viability. The 2011 CMSP included objectives for genetic analyses to assess genetic diversity, population structure, effective population size, and levels of inbreeding to identify where roads or development may be interfering with preserve integrity and population viability. Although no priority objectives for invertebrates or plants were included in the 2011 CMSP, genetic studies were completed or are ongoing for several species (e.g., San Diego fairy shrimp, Hermes copper, San Diego thorn-mint). The results of these studies are summarized briefly below and in Table V2.8-2 (see project pages on SDMMP website for full reports, http://portal.sdmmp.com).

8.3.1 Large Animal Studies

Studies of deer and mountain lions in the MSPA identified that major highways are restricting their connectivity (Bohonak and Mitelberg 2014; Vickers et al. 2015). I-5 and I-805 are isolating mule deer populations in the western part of the MSPA, where populations generally correspond to existing reserves and canyons. I-15 in the northern MSPA is restricting genetic connectivity between mountain lion populations, with lions west of I-15 belonging to the Orange County/Santa Ana Mountains subpopulation and lions east of I-15 belonging to the San Diego subpopulation (Vickers et al. 2015). Recent genetic analyses of the Santa Ana Mountain's mountain lion population indicate significant genetic restriction and minimal evidence of migration into this population in recent years. These studies indicate that genetic diversity for the Santa Ana Mountains' lions is very low (Ernest et al. 2014), lower than has been measured anywhere else in the west. In addition to I-15, other roads and highways that appear to be a potential barrier for mountain lions include SR 67, SR 76, SR 78 near Santa Ysabel, Barona Road/Wildcat Canyon Road, and Valley Center Road (Vickers 2014).

Genetic analyses of bobcats in the MSPA showed some degree of genetic differentiation between coastal bobcats west of I-5 with inland animals to the east, but did not indicate subpopulation differentiation has occurred (Jennings and Lewison 2013). This supports the assertion that the coastal and inland areas have some level of connectivity (Jennings and Lewison 2013). However, for species such as bobcat that are sensitive to habitat fragmentation, increasing fire frequency and associated loss of cover may be leading to impaired landscape connectivity. Failure to account for fire return interval departures can result in overestimation of landscape connectivity.

Table V2B.8-2. Summary of relevant Connectivity Studies

Topic/Species	Publication(s)	Summary
Mountain lion movement and genetic studies	Ernst et al. 2014; Vickers et al. 2015	Six of 9 core areas within the MSPA that were evaluated were used regularly by collared mountain lions and 1 core area was used briefly. Of the 11 linkages identified for assessment, only 3 were utilized by collared lions. It is estimated that the MSPA can support 4 to 5 reproductive females. Lions west of I-15 are part of the Orange County lion population, whereas those east of I-15 belong to lion populations that extend east of MSPA. Road mortality and depredation are major causes of mortality in San Diego County. Particular roads of concern include SR 67, SR 78, SR 76, County Road S6, Wildcat Canyon/Barona Road, and San Vicente Road. Camera trap data indicate that the majority of the lions utilizing the study area were captured and collared.
Badger movement studies	Brehme et al. 2016	Badgers were detected in MUs 3, 4, 5, and 8 and to areas east and north of the MSPA, but detections were not consistent between nor within years, which indicates the badger population is sparse, home ranges are large, and individuals likely make large daily and seasonal movements. Roads appear to be a major mortality issue where badgers still exist. Genetic analysis of badger scat is ongoing in an effort to determine feasibility of utilizing scat DNA to identify individual animals and make inferences on movement areas and population size.
Bobcat movement and genetic study	Jennings and Lewison 2013	Genetic analysis from collared and road-killed bobcats showed some degree of genetic differentiation between coastal bobcats west of I-15 and inland animals to the east, but did not indicate subpopulation differentiation has occurred. This supports the assertion that the coastal and inland areas have some level of connectivity.
Southern mule deer genetic study	Bohonak and Mitelberg 2014	The genetic data from the deer fecal analyses indicated deer in the areas analyzed have high family group home range affinity with most female young occupying at least a portion of their mother's home range as adults. Male deer moved farther but did not disperse widely. Genetic structuring of the population is occurring indicating that some linkages may not be functioning for deer. Torrey Pines, Sorrento Valley, Peñasquitos Canyon, Peñasquitos Creek, Carrol Canyon, MCAS Miramar, and Mission Trails can be considered as a separate management unit from those elsewhere in the subspecies range.

Topic/Species	Publication(s)	Summary
Wildlife Linkage Evaluation	Rochester et al., in prep.	Of the 16 linkages identified in the CMSP, 8 are estimated to be functional, having a high likelihood to provide suitable habitat and movement routes to allow wildlife to effectively move back and forth between the conserved areas. The remaining 8 linkages were estimated as nonfunctional, having significant barriers to wildlife movement, so much so that it seems very unlikely that none but the most disturbance-tolerant species will be able to move from 1 area to the next. A wide variety of taxa were detected using monitored wildlife undercrossing locations, including: snakes, lizards, invertebrates, rodents, predators, and deer. Mountain lions were not detected at any of the monitored wildlife undercrossings.
Carlsbad Wildlife Movement Analysis	City of Carlsbad, Environmental Science Associates, Center for Natural Lands Management 2015	This study evaluated connectivity for medium and large animals for over 20 potential wildlife linkages in the Carlsbad Habitat Management Plan area. Potential linkages and pinch points were first inventoried using available aerial imagery and geospatial data, and then each linkage or pinch point was evaluated in the field to document existing conditions and potential constraints to wildlife movement. Use of identified wildlife linkages was then monitored for 12 months via track and camera trap studies. Bobcat and coyote were documented at nearly all studied linkages, while deer were documented at 2 linkages. Surveys identified the need for maintenance of several pinch points that are overgrown or are otherwise unpassable for wildlife due to pooling of water or fencing.
Coastal cactus wren genetic study	Barr and Vandergast 2014	This study found many distinct genetic clusters, relatively small effective population sizes, and low genetic diversity in small populations in San Diego County, particularly in South County. The small effective population sizes for the Otay Valley and the Sweetwater-Lake Jennings populations and the lack of connectivity between these populations are of great concern. This species is in significant trouble and the southern MSPA populations could disappear in the near future without intervention.

Topic/Species	Publication(s)	Summary
California gnatcatcher	Vandergast et al. 2014	Regional genetic studies performed for the California gnatcatcher in Ventura, San Bernardino, Los Angeles, Orange, Riverside and San Diego Counties found that Palos Verdes, Ventura, and Coyote Hills in Orange County composed statistically distinguishable populations, while all other aggregations from the eastern Los Angeles Basin through southern San Diego County formed a single population.
Arroyo toad genetic study	Fisher, Brown (ongoing)	Study is ongoing by USGS to determine the degree of genetic variation within and between populations of arroyo toad in San Diego County.
Southwestern pond turtle genetic study	Fisher et al. 2014	Studies of the southwestern pond turtle performed by USGS throughout southern California using mitochondrial DNA have identified that southwestern pond turtle genetics are distinct between watersheds in southern California.
Small vertebrates	Tracey et al. 2014	The results supported the short-term effectiveness of the added structure treatments on small vertebrate use of underpasses and suggested that these rates changed on the specific side the treatment was applied rather than the entire underpass.
San Diego fairy shrimp genetic study	Bohonak and Simovich 2013	Studies suggest that local pool complexes were historically isolated but are currently homogenized in high use sites.
Hermes copper butterfly	Strahm et al. 2012; USFWS 2013	The genetic study showed there is little genetic differentiation in Hermes copper populations, although some differentiation occurs at the edges of their range (e.g., Meadowbrook Ecological Reserve, Boulder Creek Road, and Mission Trails Regional Park) (Strahm et al. 2012). These results likely represent historical connectivity patterns as, more recently, dispersal appears constrained with few of the 14 sites recolonized following population extinction from the 2003 and 2007 wildfires

Topic/Species	Publication(s)	Summary
Native bees (*Hymenoptera: Anthophila*)	Hung and Holway 2014 (see Vol 3 App. for Connectivity Workshop 2014 Project Summary)	In fragments of scrub habitat <40 hectares in size (e.g., open space parks embedded in urban matrix), native bee species richness and genus richness were roughly 35% lower than those in large, intact patches of scrub habitat >400 hectares in size (e.g., Mission Trails Regional Park), despite similar richness and density of blooming native plant species in the 2 types of habitats.
Stephens' kangaroo rat genetic study	Shier and Navarro 2016	The results of this regional study show the highest genetic variation in terms of allelic richness primarily in northern populations in Riverside County and the lowest in the southernmost populations (i.e., Ramona Grasslands, Rancho Guejito, MCB Camp Pendleton) suggesting that the species may have expanded southward from an ancestral population in the north of the current range. The study implies that recent effects of habitat fragmentation and population isolation in Stephens' kangaroo rat have created a metapopulation-like structure in the species across its current range.
San Diego thornmint genetic study	CNLM 2014	Results from this study indicated that the species has significant genetic structure and that differentiation among populations is consistent with gene flow, decreasing as a function of geographic distance. The overall genetic differentiation observed in San Diego thornmint is slightly lower than mean values reported for endemic annuals, but higher than that reported for other members of the Lamiaceae family. Populations that occur within a geographic region (ca. 20 kilometers) were more genetically similar than populations separated by greater distances.
San Diego ambrosia genetic study	McGlaughlin and Friar 2007	Genetic studies indicate that there is a high degree of genetic variation within 3 sampled San Diego ambrosia populations, hinting that sexual reproduction must have occurred at times in the past (Friar 2005). There is very little gene flow between nearby occurrences, indicating that large populations are necessary to maintain genetic diversity.
MSP rare plant genetic studies	Vandergast ongoing	Genetic studies are underway by USGS for the following 6 MSP rare plant species: Salt marsh bird's-beak, Orcutt's bird's-beak, Encinitas baccharis, Otay tarplant, willowy monardella, and San Diego thornmint.

Surveys conducted during the past 5 years in the MSPA for the American badger have identified that the badger population is sparse, home ranges are large, and individuals likely make large daily and seasonal movements (Brehme et al. 2016). Genetic analysis of badger scat is ongoing to determine feasibility of utilizing scat DNA to identify individual animals and make inferences on movement areas and potential connectivity (Brehme et al. 2016). Future work on badgers will focus less on their usefulness for indicating connectivity for large animals in general and more on specifically tracking this species' movement in the MSPA using telemetry to inform badger management.

8.3.2 Small Animals

The San Diego Zoo has completed an analysis of Stephens' kangaroo rat population genetics across the species geographic range (Shier and Navarro 2016). The results of this study show the highest genetic variation in terms of allelic richness primarily in northern populations (i.e., Lake Perris, San Jacinto Wildlife Area, March Air Reserve Base, Sycamore Canyon, Lake Mathews, etc.) and the lowest in the southernmost populations (i.e., Ramona Grasslands, Rancho Guejito, Marine Corps Base Camp Pendleton) suggesting that the species may have expanded southward from an ancestral population in the north of the current range. The study implies that recent effects of habitat fragmentation and population isolation in Stephens' kangaroo rat have created a meta-population-like structure in the species across its current range.

Genetic studies for the arroyo toad in San Diego County are underway, using genetic material collected during past and present regional surveys to evaluate the degree of genetic variation within and between populations and to possibly identify genetic bottlenecks or barriers; this information will also be used to determine source populations to use in reestablishing arroyo toad in previously occupied areas (R. Fisher, USGS, in prep.).

Genetic studies are currently underway across southern California for the Blainville's horned lizard (J. Richmond, USGS, in prep.). The study will provide data on whether horned lizard populations are genetically interconnected across the NCCP reserve system, or whether gene flow has occurred recently but is no longer possible due to habitat fragmentation.

Recent genetic studies of the southwestern pond turtle performed by USGS throughout southern California using mitochondrial DNA have identified that southwestern pond turtle genetics are distinct between watersheds in southern

California (Fisher et al. 2014). All 4 populations sampled in southern San Diego County in the San Diego River, Sweetwater River, and Tijuana River watersheds appear to have gone through a decline in population size in the past. Based on current knowledge, it was recommended that most of the populations should be managed separately as they represent unique genetic signatures; managing within watersheds should be the priority.

8.3.3 Birds

Regional genetic studies performed for the California gnatcatcher in Ventura, San Bernardino, Los Angeles, Orange, Riverside, and San Diego Counties found that Palos Verdes, Ventura, and Coyote Hills in Orange County comprised statistically distinguishable populations, while all other aggregations from the eastern Los Angeles Basin through southern San Diego County formed a single population (Vandergast et al. 2014).

Genetic studies of the coastal cactus wren have identified that habitat loss and fragmentation and overall poor dispersal ability have led to genetic differentiation between clusters of wrens and loss of genetic diversity over the last 100 years (Barr and Vandergast 2014). In San Diego County, there are currently 4 distinct genetic clusters. The 2 genetic clusters in southern San Diego County—the Otay River Valley and Sweetwater/Lake Jennings genetic clusters—both have small effective population sizes and have little connectivity between them.

8.3.4 Invertebrates

A recent genetic study of Hermes copper butterfly found regular movement among sites within 1 kilometer, although some individuals appear to undertake longer distance movements (Deutschman et al. 2010; Strahm et al. 2012). Topography, habitat fragmentation, and other landscape features may affect dispersal ability and even reduce connectivity between populations in proximity (Deutschman et al. 2010; Strahm et al. 2012). In other cases, topography and vegetation may enhance movement through the landscape. The genetic study showed there is little genetic differentiation in Hermes copper populations, although some differentiation occurs at the edges of their range (e.g., Meadowbrook Ecological Reserve, Boulder Creek Road, and Mission Trails Regional Park) (Strahm et al. 2012). These results likely represent historical connectivity patterns as, more recently, dispersal appears constrained, with only a few of the 14 sites recolonized following population extinction from the 2003 and 2007 wildfires (Strahm et al. 2012; USFWS 2013).

Genetic studies for the San Diego fairy shrimp (Bohonak and Simovich 2013) conducted for City of San Diego lands throughout San Diego County suggest that local pool complexes were historically isolated but are currently homogenized in high use sites. Studies suggest that in order to maximize the likelihood of success, newly created pools should probably be stocked from a very local source (Bohonak and Simovich 2013).

Studies of bees across Conserved Lands in the MSPA (Hung and Holway 2014, see Vol 3 App. for Connectivity Workshop 2014 Project Summary) found that, in fragments of scrub habitat <40 hectares in size (e.g., open space parks embedded in urban matrix), native bee species richness and genus richness were roughly 35% lower than those in large, intact patches of scrub habitat >400 hectares in size (e.g., Mission Trails Regional Park), despite similar richness and density of blooming native plant species in the 2 types of habitats. Possible drivers of loss of bee diversity in fragments are not known but could include loss of host plants or nesting substrate or failure to recolonize following natural processes of local metapopulation extinctions.

8.3.5 Plants

Genetic studies for San Diego thorn-mint completed by the Center for Natural Lands Management (Rogers 2014), indicated that the species has significant genetic structure and that differentiation among populations is consistent with gene flow, decreasing as a function of geographic distance. The overall genetic differentiation observed in San Diego thorn-mint is slightly lower than mean values reported for endemic annuals, but higher than that reported for other members of the Lamiaceae family. Populations that occur within a geographic region (ca. 20 kilometers) were more genetically similar than populations separated by greater distances. This pattern indicates some level of gene flow may continue between populations, despite the limited potential for long-distance gene flow in this insect-pollinated ephemeral winter annual. Alternatively, these populations may have only recently become genetically isolated, and allele frequencies have not yet differentiated. These results also provide evidence for restricting seed dispersal among highly divergent populations. Differentiation among populations appears to be most strongly related to longitude (and elevation) and less so to latitude (i.e., north-south gradient).

Genetic studies for San Diego ambrosia (McGlaughlin and Friar 2006) indicate a high degree of genetic diversity within 3 sampled San Diego ambrosia populations, hinting that sexual reproduction must have occurred at times in the past. There is very little gene flow between nearby occurrences, indicating that large populations are necessary to maintain genetic diversity.

8.3.6 Linkage Studies

In addition to species-level surveys, the 2011 CMSP included an objective to conduct preliminary assessments of 16 priority linkages for their potential functionality in MUs 3, 4, 5, and 6. Based on past monitoring data and available satellite imagery and land use data, the assessment, conducted by USGS, revealed that 8 of the 16 linkages likely support movement for the 5 focal species assessed, while the remaining 8 are constrained and possibly nonfunctional for all but the most disturbance-tolerant wildlife species (C. Rochester, USGS, in prep.).

USGS also conducted detailed track and camera monitoring of many linkages previously studied by CBI (CBI 2002, 2003) to determine if physical connectivity along the various linkages was still present. While a wide variety of taxa were documented to be using several of the undercrossing locations (i.e., snakes, invertebrates, rodents, and deer), other monitored locations were determined not to provide connectivity for terrestrial species for a variety of factors, including lack of wildlife infrastructure and habitat loss due to development and fencing.

USGS performed a study between 2012 and 2013 to evaluate whether adding structure (concrete blocks) to undercrossings enhances their use by small vertebrate species (Tracey et al. 2014). For this study, in 2012, USGS studied wildlife use of 8 underpasses in the MSPA using camera traps. Following an initial 6-month study, USGS added structure, in the form of concrete blocks spaced 5 meters apart, on 1 side of 4 of the 8 underpasses. Two months following structure placement, USGS repeated camera trap surveys of all 8 sites for 6 additional months to evaluate if there was enhanced use of undercrossings by small vertebrates. The results supported the short-term effectiveness of the added structure treatments on small vertebrate use and suggested that these rates changed on the specific side the treatment was applied rather than the entire underpass.

In 2014, the City of Carlsbad, Environmental Science Associates, and the Center for Natural Lands Management evaluated connectivity for medium and large animals for over 20 potential wildlife linkages in the Carlsbad Habitat Management Plan area (City of Carlsbad et al. 2015). Potential linkages and pinch points were first inventoried using available aerial imagery and geospatial data, and then each linkage or pinch point was evaluated in the field to document existing conditions and potential constraints to wildlife movement. Use of identified wildlife linkages was then monitored for 12 months via track and camera trap studies. Bobcat and coyote were documented at nearly all studied linkages, while deer were documented at 2 linkages. Surveys identified the need for maintenance of several pinch points that are overgrown or are otherwise unpassable for wildlife due to pooling of water or fencing.

8.4 MANAGEMENT AND MONITORING APPROACH

The overarching and interrelated goals for protecting and restoring connectivity among core habitat areas within the MSPA and other regional conservation areas are to:

- Ensure the persistence of species across the preserve system and
- Maintain ecosystem functions across the landscape.

The approach for managing connectivity is divided into 2 parts: general and species-specific. General connectivity objectives focus on maintaining landscape permeability across the MSPA, within and between Core Habitat Areas, and benefitting the largest number of species, while species-specific objectives have been developed for those MSP species identified as at highest risk from loss due to fragmentation, and for which specialized connectivity objectives (i.e., maintaining genetic connectivity, restoring habitat) are required to ensure their persistence in the MSPA.

8.4.1 General Approach Objectives

The general approach for managing connectivity focuses on assessing how well existing lands are connected and identifying management actions to enhance connectivity. The primary objectives for General Connectivity Monitoring and Management are to:

- Conduct preliminary linkage evaluations to document the extent to which currently conserved and future conserved linkages connect Core Habitat Areas (structurally and, where data exist, functionally) for a wide variety of species. Where possible, identify the optimal spatial configuration of each linkage based on expert opinion and available habitat suitability modeling. Identify specific actions needed to secure functional connectivity.

- Based on linkage evaluations and results from past connectivity monitoring studies, identify priority linkages for further planning and long-term management and monitoring.
- For each priority linkage, prepare a management plan that includes (a) a spatially explicit linkage design based upon expert opinion and available data (b) identified and prioritized actions (e.g., planning, research, restoration, infrastructure improvement, land acquisition) needed to protect or restore connectivity, and (c) long-term monitoring to evaluate the success of management actions.
- Implement linkage improvement recommendations based on past studies and quantitative and qualitative linkage monitoring results (e.g., culvert maintenance, fencing, land acquisition).
- Evaluate various methods used in previous connectivity monitoring efforts in the MSPA to develop a long-term quantitative and qualitative monitoring strategy for priority linkages.
- Identify, through periodic spatial assessments and available modeling, the ongoing status of Core and Linkage areas to inform the status of regional connectivity objectives and to identify additional monitoring or conservation measures needed to better understand and maintain connectivity.
- Participate, as appropriate, in regional efforts targeted at identifying and prioritizing BMPs and funding in support of connectivity (research, land acquisition and wildlife crossing infrastructure improvements).

Below is more description of the management and monitoring objectives for the threat of loss of connectivity. For the most up-to-date goals, objectives, and actions, go to the MSP Portal Loss of Connectivity summary page: http://portal.sdmmp.com/view_threat.php?threatid=TID_20160304_1454.

Perform Linkage Evaluations

Linkages within the MSPA have been identified in Figure V2B.8-5. As mentioned above, some of these linkages have received preliminary evaluations to assess structural connectivity and some are being evaluated currently (e.g., North County linkage evaluation). For those linkages not yet evaluated or that need further study, evaluations should review the status of the structural connectivity (and functional connectivity, where data are available) for each of the linkages using expert opinion informed by data from various sources, including past monitoring data, spatial assessments using available aerial photography, satellite imagery, land use and vegetation data, and field surveys. These evaluations should identify for each linkage (1) the conserved habitat blocks to be connected by the linkage, (2) species targets that the linkage is intended to protect, and (3) the level of likely permeability for selected target species, as well as barriers to connectivity. This information will be used to identify specific actions to improve connectivity (e.g., further study/modeling, habitat restoration, land acquisition, alternative linkage designs, wildlife crossing infrastructure, and culvert maintenance).

Identify Priority Linkages

Once linkage evaluations have been completed, linkages within the MSPA will be prioritized for further linkage planning, management, and long-term monitoring based on several factors, including (1) the diversity of species and habitats supported; (2) the level of existing and potential conserved habitat to be connected; (3) the severity and immediacy of threat to connectivity posed by existing or proposed development, and (4) the importance of the linkage to sustaining regional connectivity, both within and beyond San Diego County.

Prepare Linkage Management Plans

Identified priority linkages will undergo further study to develop management plans that identify (1) spatially explicit linkage design(s), (2) management that outlines specific locations for prioritized actions to protect or enhance connectivity, and (3) monitoring to guide long-term evaluation of linkage performance. Linkage designs will be informed by linkage evaluations, expert opinion, past/future connectivity monitoring, and available habitat suitability and species movement modeling. Linkage design should incorporate linkage design procedures developed by Beier et al. (2008) and Beir and Brost (2010) as available data and time allow.

Linkage management plans will outline specific locations and types of actions to be implemented to enhance connectivity, including land acquisition, restoration, or infrastructure improvements. Linkage monitoring plans will identify the type of long-term monitoring required to evaluate linkage performance (quantitative, spatial assessments, inspect and manage). Where priority linkages include major roadways that are demonstrated to be a barrier to wildlife movement (SR 67, SR 94, SR 52, SR 78, SR 76, and SR 79), efforts should be made to identify needed wildlife crossing infrastructure improvements to enhance linkage function for target species.

Wildlife infrastructure improvement plans are complete or nearly complete for SR 67 and SR 94 and are intended to guide the placement, design, and long-term effectiveness monitoring of planned wildlife crossing infrastructure. These plans should serve as a model for preparing future wildlife crossing infrastructure improvement plans for priority roads in the MSPA.

Implement Linkage Improvement Recommendations and Monitor their Effectiveness

Recommendations outlined in completed linkage evaluations and Linkage Management Plans to enhance connectivity will be implemented as funding becomes available, and may include land acquisition, habitat restoration, culvert maintenance, directional wildlife fencing, addition of structure to increase use of undercrossings by small animals, or removal of man-made barriers. Connectivity enhancements should be monitored for their effectiveness following implementation using methods developed in the qualitative and quantitative linkage monitoring plans.

Implement Wildlife Connectivity Enhancements for SR 94 and Monitor their Effectiveness

A framework wildlife infrastructure improvement plan has been prepared for 12 miles of SR 94 to guide the placement of wildlife crossing structures aimed at minimizing roadkill and providing movement opportunities for multiple wildlife taxa (CBI 2015). While many of the recommendations, such as the construction of wildlife crossing structures, will be delayed until they can be integrated into future road widening projects, several recommendations should be implemented in the short term, such as directional wildlife fencing, culvert maintenance, additional wildlife monitoring, and habitat restoration. Connectivity enhancements should be monitored for their effectiveness following implementation using methods developed in the qualitative and quantitative linkage monitoring plans.

In addition, land managers should work with the California Department of Transportation to proactively discuss and evaluate locations and designs for wildlife crossing structures presented in the plan to inform road improvement design studies and plans as they are initiated.

Prepare Wildlife Infrastructure Improvement Plans for SR 67

The SR 67 Wildlife Infrastructure Improvement Plan is currently being expanded to include planning for the protection of nearby associated linkages beyond SR 67

(Jennings, in prep.). The plan will incorporate a multi-species movement and resistance-based assessment of functional connectivity and site-specific linkage designs, which will inform specific locations and types of structures to enhance connectivity across SR 67. The plan will also identify crossing locations and designs for nearby roads that are a barrier to wildlife movement, including Wildcat Canyon Road, Scripps Poway Parkway, and Mount Woodson Road. In addition to identifying wildlife crossing infrastructure needs, the plan will identify land protection needs in key linkage areas.

Implement Wildlife Connectivity Enhancements for SR 67 and Monitor Connectivity Enhancements for their Effectiveness

Once the SR 67 Wildlife Infrastructure Improvement Plan is complete, specific actions that can be implemented in advance of planned road improvement/ widening will be identified and prioritized for implementation, such as directional wildlife fencing, culvert maintenance, additional wildlife monitoring, land acquisition, and habitat restoration. Connectivity enhancements should be monitored for their effectiveness following implementation using methods developed in the wildlife infrastructure improvement plans and qualitative and quantitative linkage monitoring plans.

Develop Best Practices

As part of linkage evaluations, follow-up monitoring should be conducted to reassess the effect of added structure on the use of underpasses by small and large vertebrates (Tracey et al. 2014). Based on results of the study, “best practices” (BMPs) for increasing underpass use by small vertebrates should be developed.

Develop and Implement Quantitative Linkage Monitoring Protocols

Development of long-term monitoring protocols to assess functional connectivity should involve the review and refinement of various quantitative monitoring methods used in the MSPA over the last 15 years to identify BMPs and priority linkages for connectivity monitoring. Opportunities for integrating other regional monitoring data into the broader MSP Roadmap connectivity monitoring program should be evaluated and incorporated, as appropriate (e.g., San Diego Tracking Team, feral pig camera monitoring, genetic studies, and other species-specific connectivity monitoring methods). Specifically, the feasibility of integrating camera trap data across various monitoring efforts in the region should be evaluated to assess regional connectivity for various species. If determined that it is feasible to integrate camera data across the region, standardized camera trap monitoring protocols should be developed and implemented to ensure consistent data are collected.

Develop and Implement Qualitative Linkage Monitoring Protocols

In addition to quantitative field-based monitoring, an inspect and manage monitoring program should be developed and implemented for wildlife undercrossings and choke points that are within or abut Conserved Lands. The program should be developed with the input of land managers, and should entail yearly qualitative monitoring of choke points to assess wildlife use, threats, and to identify management actions to abate threats.

Conduct Regional Landscape Connectivity Spatial Analyses

Periodic spatial evaluation and reassessment of the intactness of habitat in cores and linkages across the MSPA should be conducted to inform regional connectivity management. Land conversion resulting from urban or agricultural development and other impacts within a non-conserved or partially conserved linkage can render the linkage ineffective. Documenting the current level of structural connectivity within the MSPA should include an assessment of landscape features, including patches of natural vegetation, agriculture, urban areas, land use, and major roads. Other relevant data layers, such as land facets (Beier and Brost 2010), climate change forecasts, and land use projections can be developed and integrated to provide further insight into regional connectivity management needs. Overlaying conservation status on these features will identify, at the regional scale, the degree to which structural connectivity is currently conserved in Core Habitat Areas and where linkages need to be maintained, both within and between cores, through land acquisition, restoration, or road infrastructure improvements. The periodic assessment of landscape features will allow land managers to assess, over time, how habitat intactness and, thus, connectivity, is changing with the expansion of urban, agricultural, and infrastructure land uses.

Participate in Tri-County Inter-Agency Connectivity Coalition

In 2015, Orange County Transportation Agency convened the first “Tri-County Inter-Agency Coordination Group” meeting to initiate regional discussions and strategies for managing and monitoring species and habitat connectivity in Orange, San Diego, and Riverside Counties. The group, composed of local and regional transportation agencies, Non-Governmental Organizations (NGOs), wildlife agencies, and land managers, is working to prioritize habitat connectivity needs particularly as it relates to roads, and will be working cooperatively to elevate the issues and strategies for enhancing connectivity in the 3-county area.

Convene a Wildlife and Roads Working Group

Protecting and enhancing connectivity across major roads will require the implementation of linkage assessments and monitoring as identified above to inform the planning process, but will also require ongoing outreach and collaboration with transportation agencies to identify future opportunities for incorporating wildlife crossing infrastructure into future road improvement projects. A "Wildlife and Roads" working group is recommended to be established to allow regular communication between wildlife agencies, land managers, and transportation planners to identify opportunities for integrating wildlife crossing infrastructure into planned road improvements.

8.4.2 Species-Specific Approach

Connectivity needs for different species can vary widely. Some species (e.g., mountain lions, bobcat, deer, American badger) are able to move long distances through diverse habitats. For these species, maintaining landscape linkages that have relatively few landscape barriers but do not support breeding individuals may be adequate to provide for movement between areas where populations of those species persist. However, other species that have shorter dispersal distances (e.g., Blaineville's horned lizard, Stephens' kangaroo rat, coastal cactus wren) likely need live-in habitat within the linkages for movement to occur through generations rather than through specific individual dispersal. For these species, maintaining or restoring breeding habitat for small populations in the linkage area may be necessary to achieve a functional linkage between blocks of habitat supporting larger groups of animals.

Recognizing that different species have different habitat needs for connectivity, several expert-based discussions facilitated by the SDMMP were held between November 2009 and July 2010 and again in July 2014 to identify and inform species-specific approaches for connectivity monitoring. A technical working group, organized around taxonomic groups, met to discuss connectivity issues including species, habitats, ecosystem function, monitoring methodologies, and potential approaches to monitoring. The results of connectivity technical meetings are presented in Appendix 11.

Species for which connectivity goals and objectives have been identified as part of their management and monitoring approach are identified in Table V2B.8-3. Three species identified for baseline connectivity monitoring in the 2011 CMSP will not be given priority during the 2017–2021 monitoring period. Regional genetic studies for the California gnatcatcher have sufficiently documented the current level of connectivity to inform management. Monitoring studies conducted during the past 5 years for the American badger have identified that the species is too sparsely distributed to be an effective target for connectivity monitoring. Finally, studies of bobcat connectivity conducted by San Diego State University have sufficiently identified the current level of connectivity for this species; however, the bobcat may be considered as an indicator for assessing functional connectivity under the long-term connectivity monitoring program.

Species-level objectives range from developing species-specific habitat suitability or movement models to inform the location of restoration or wildlife crossing infrastructure improvements, to enhancing connectivity and genetic studies to inform connectivity needs for specific rare plant populations. See each species section for details on objectives identified to reduce the threat of loss of connectivity. Use the MSP Portal for the most updated list of species with Loss of Connectivity objectives.

Table V2B.8-3. MSP plant and animal species with specific connectivity management and monitoring objectives

Scientific Name	Common Name	Management Category	Summary Page Link
Plants			
Acanthomintha ilicifolia	San Diego thorn-mint	SO	https://portal.sdmmp.com/view_species.php?taxaid=32426
Acmispon prostratus	Nuttall's acmispon	SO	https://portal.sdmmp.com/view_species.php?taxaid=820047
Ambrosia pumila	San Diego ambrosia	SO	https://portal.sdmmp.com/view_species.php?taxaid=36517
Aphanisma blitoides	Aphanisma	SL	https://portal.sdmmp.com/view_species.php?taxaid=20679
Baccharis vanessae	Encinitas baccharis	SO	https://portal.sdmmp.com/view_species.php?taxaid=183764
Brodiaea filifolia	Thread-leaved brodiaea	SS	https://portal.sdmmp.com/view_species.php?taxaid=42806
Brodiaea orcuttii	Orcutt's brodiaea	SO	https://portal.sdmmp.com/view_species.php?taxaid=42815
Chloropyron maritimum ssp. maritimum	Salt marsh bird's-beak	SL	https://portal.sdmmp.com/view_species.php?taxaid=834234
Chorizanthe orcuttiana	Orcutt's spineflower	SL	https://portal.sdmmp.com/view_species.php?taxaid=21019
Clinopodium chandleri	San Miguel savory	SL	https://portal.sdmmp.com/view_species.php?taxaid=565077
Deinandra conjugens	Otay tarplant	SS	https://portal.sdmmp.com/view_species.php?taxaid=780273
Dicranostegia orcuttiana	Orcutt's bird's-beak	SL	https://portal.sdmmp.com/view_species.php?taxaid=834156
Dudleya blochmaniae	Blochman’s dudleya	SL	https://portal.sdmmp.com/view_species.php?taxaid=502165
Erysimum ammophilum	Coast wallflower	SL	https://portal.sdmmp.com/view_species.php?taxaid=22928
Monardella viminea	Willowy monardella	SL	https://portal.sdmmp.com/view_species.php?taxaid=833060
Nolina interrata	Dehesa nolina	SO	https://portal.sdmmp.com/view_species.php?taxaid=42992

	Scientific Name	Common Name	Management Category	Summary Page Link
	Tetracoccus dioicus	Parry's tetracoccus	SS	https://portal.sdmmp.com/view_species.php?taxaid=28420
Invertebrates				
	Euphydryas editha quino	Quino checkerspot butterfly	SL	https://portal.sdmmp.com/view_species.php?taxaid=779299
	Euphyes vestris harbisoni	Harbison's dunn skipper	SL	https://portal.sdmmp.com/view_species.php?taxaid=707282
Amphibians				
	Anaxyrus californicus	Arroyo toad	SO	https://portal.sdmmp.com/view_species.php?taxaid=773514
Reptiles				
	Emys pallida	Southwestern pond turtle	SL	https://portal.sdmmp.com/view_species.php?taxaid=668677
	Phrynosoma blainvillii	Blainville's horned lizard (Coast horned lizard, San Diego horned lizard)	VF	https://portal.sdmmp.com/view_species.php?taxaid=208819
Birds				
	Aquila chrysaetos canadensis	Golden eagle	SO	https://portal.sdmmp.com/view_species.php?taxaid=175408
	Athene cunicularia hypugaea	Western burrowing owl	SL	https://portal.sdmmp.com/view_species.php?taxaid=687093
	Campylorhynchus brunneicapillus sandiegensis	Coastal cactus wren	SO	https://portal.sdmmp.com/view_species.php?taxaid=917698
Mammals				
	Lepus californicus bennettii	San Diego black-tailed jackrabbit	VF	https://portal.sdmmp.com/view_species.php?taxaid=900973
	Odocoileus hemionus fuliginata	Southern mule deer	SS	https://portal.sdmmp.com/view_species.php?taxaid=898459
	Puma concolor	Mountain lion	SL	https://portal.sdmmp.com/view_species.php?taxaid=552479
	Taxidea taxus	American badger	SL	https://portal.sdmmp.com/view_species.php?taxaid=180565

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