Table V1.2-1. Examples of how results and recommendations from species management and monitoring projects are incorporated into the MSP Roadmap.

Species	Project Description(s)	Results	Recommendations & Application to MSP	References
Rare Plants	Technical review of monitoring data collected for 24 rare plant species by 3 jurisdictions from 1999 to 2009. Five monitoring techniques assessed [1].	Rare plant monitoring projects from 1999 to 2009 were unable to reliably determine total population sizes or trends because of: inconsistency in field techniques, poor data handling, inappropriate sampling design, and extreme annual variation in plant population abundances [1,2].	Recommended sampling an index of population size and habitat conditions over time to capture the natural range in variation [1]. Advised developing institutional metadata and shared databases, establishing a set of core monitoring protocols, and specifying monitoring goals to address management needs. These recommendations form the basis of the rare plant "Inspect and Manage" objectives in the MSP Roadmap.	[1] McEachern & Sutter 2010; [2] McEachern et al. 2007
Hermes Copper Butterfly	From 2010 to 2016, conducted population surveys and collected habitat covariate data to create a conceptual model [3,4]. Developed methods to collect non-lethal genetic samples [5], conducted genetics study [4], and developed BMPs for captive rearing and translocating adults/eggs [6, 8].	Since 2012, populations declined with drought, no individuals at northern sites in 2016 [9] and little recolonization after 2003 and 2007 wildfires [7]. Genetic analyses suggest populations in north and west differ from central portion of range [4]. Overall genetic patterns may reflect historic conditions and not recent population isolation from fire and development. Egg and adult translocations appear successful [7]. Habitat assessments identified sites needing restoration, especially in burned areas [7].	Recommended: continue monitoring sentinel sites to identify environmental variables associated with annual density [4,7]; continue surveys in northern populations to determine status [4,9]; survey where butterflies were extirpated by wildfires to document recolonization [3,4,7]; continue translocation studies, especially during average rainfall years [8]; and restore degraded habitat, particularly in areas recovering from 2003 and 2007 wildfires [7,9]. The MSP Roadmap builds upon previous work with objectives to: complete captive rearing and translocation BMPs; develop and implement a management plan with site-specific habitat restoration actions; prepare a long term monitoring plan; and implement fire ignition prevention actions and postfire monitoring and recovery actions.	[3] Deutschman et al. 2011; [4] Strahm et al. 2012; [5] Marschalek et al. 2013; [6] Marschalek & Deutschman 2014; [7] Marschalek & Deutschman 2016a; [8] Marschalek & Deutschman 2016b; [9] Marschalek & Deutschman 2016c

Species	Project Description(s)	Results	Recommendations & Application to MSP	References
Southwestern Pond Turtle	Began testing BMPs in 2009, monitored population response to removing nonnative aquatic species, captive rearing and reintroducing juvenile turtles [10,11].	In 2005 - 38 adults and no juveniles at Sycuan Peak ER due to predation by nonnative aquatic species [10]. Beginning in 2009, removed 5 predator species allowing natural recruitment and reintroduced 10 captive reared juveniles to double population size by 2015 [10,11].	Pond turtle management BMPs were recommended for establishing new occurrences and augmenting existing ones that lacked juvenile recruitment [11]. The MSP Roadmap includes objectives to manage invasive aquatic species, and translocate adult and captive reared juveniles to establish pond turtle populations in additional areas of the MSPA.	[10] Brown et al. 2012; [11] Brown et al. 2015.
Coastal Cactus Wren	2011 to 2013, conducted genetics study [12] and population monitoring in MSPA. Regional cactus nursery and cactus scrub restoration projects initiated from 2009 to 2016. Beginning in 2014 conducted surveys, cactus mapping and a Coastal Cactus Wren Demography, Vegetation and Arthropod Study in south San Diego County.	3 genetic clusters in the MSPA isolated by habitat fragmentation [12]. Sites with less habitat associated with smaller effective population size, lower allelic richness, and higher relatedness. Genetic and banding studies show poor wren dispersal ability in fragmented habitat [12,13]. Cactus restoration can expand small populations and enhance connectivity. Ongoing demographic study is identifying plant species associated with arthropod food resources.	Genetics study recommends expanding populations and enhancing connectivity to prevent loss of genetic diversity and reduce potential inbreeding [12]. South county cactus wren management plan [14] prioritizes creating a cactus nursery, expanding small populations and enhancing between Otay and San Diego/El Cajon genetic clusters. ICR's restoration analyses suggest increasing small occurrences and expanding connectivity within the San Pasqual genetic cluster [15]. When completed, incorporate results from the demographic study to specify restoration palletes and planting design to maximize food availability. Recommendations are incorporated into MSP Roadmap objectives.	[12] Barr et al. 2015; [13] Kamada & Preston 2013; [14] TNC & SDMMP 2015; [15] Conlisk et al. 2014

Species	Project Description(s)	Results	Recommendations & Application to MSP	References
Coastal California Gnatcatcher	Conducted occupancy surveys in the MSPA in 2002, 2004, 2007, and 2009 [16,17]. Tested and refined monitoring protocol for greater efficiency [18]. In 2011, initiated a genetic study to determine population structure and connectivity throughout southern California, including the MSPA [19].	In 2002, overall occupancy was 26%, but varied with modeled habitat quality [16]. Between 2004 and 2009, extinction rate was constant, while colonization greater in higher quality habitat at lower elevations and postfire population recovery was slow [17]. Survey effort was 35% less for area-searches than point counts [18]. Entire U.S. range forms 1 genetic cluster, with a few aggregations in northern fragments [19]. Weak association between genetic differentiation and distances through suitable habitat, indicating most movement and gene flow is through suitable habitat, not urban development.	Habitat model provided a good predictor of suitable habitat and useful for defining monitoring sampling frame [16]. 2002-2009 survey results indicate habitat restoration priorities are lower elevation sites nearer coast in high and very high modeled habitat [17]. Shifting to area-search method was recommended to reduce survey costs [18]. Unlike cactus wren, it is unnecessary to invest limited resources in enhancing linkages or creating new connections; maintaining existing linkages is sufficient for gnatcatcher connectivity in the MSPA [19]. These recommendations are included in MSP Roadmap objectives. Fire study initiated in 2015 and regional monitoring in 2016 use area-search protocol and new vegetation protocol to further refine habitat relationships. MSP Roadmap objectives include using results from ongoing and completed studies to determine if and where restoration is needed and to develop restoration habitat specifications.	[16] Winchell & Doherty 2008; [17] Winchell & Doherty 2014; [18] Miller & Winchell 2016; [19] Vandergast et al. 2014
Western Burrowing Owl	In 2010 began developing strategy for recovering burrowing owls in MSPA [20,21]. Tested BMPs for managing grassland vegetation [22] and facilitating burrow creation by	Mowing and drought reduced grass density [22] and squirrels persisted at 2 of 4 translocation plots, despite drought [23]. Providing cover and grazing at a 5th site increased squirrel activity near existing colony [23]. Combining vegetation management and squirrel translocation created owl habitat with persistent engineering effects [22, 23]. Downward trend	Mowing and squirrel translocations may not be cost effective over long term [22]. Need to evaluate other management methods such as: encouraging squirrel colonization into habitat created by vegetation management near existing populations; evaluating grazing and fire as vegetation management tools; and determining if squirrels provide vegetation management through ecosystem engineering [23]. Most important goal is re-establishing owls in restored habitats; most suitable owl habitat is developed. Natural burrows favored over artificial burrows. If use artificial burrows, recommend design	[20] Deutschman & McCullough 2012; [21] Wisinski et al. 2012; [22] Deutschman & McCullough 2015; [23] Hennessy et al. 2015; [24] Shier et al.

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	California ground squirrels [22, 23, 24]. Starting in 2013, studied owl nesting, foraging, genetics, population dynamics, and spatial use to inform manage-ment [23]. Developed habitat suitability model to identify potential nodes for establishing breeding populations.	in owl reproduction during drought [23]. Owls forage <700m from nesting burrows. Infanticide, indicative of food limitation, and predation caused nestling mortality. Artificial burrows fledged fewer young. Genetics indicate seasonal monogamy and sufficient genetic diversity. Suitable habitat at lower elevations with warmer and drier spring and higher %CSS, grassland and agriculture at 1km scale.	tested in 2016 combined with annual monitoring and burrow maintenance. Developing and implementing owl management plan are MSP Roadmap objectives. Management plan uses BMPs and monitoring results to prioritize management actions to be implemented and monitored for effectiveness. MSP Roadmap objectives continue research to understand population responses to changing environmental conditions, monitoring success of active translocation to establish new population nodes, and monitoring and maintaining artificial burrows with optimal design at priority sites.	2016
Mountain Lion	In 2001, began regional study of lion movements [25], interactions with humans and domestic animals, predator-prey interactions, exposure to disease and environmental toxins, and genetics [26].	Annual survival very low (~50%) [25]. Main causes of death were depredation permits and vehicle collisions. Lions in Santa Ana Mountains had lowest genetic diversity in state and there was also low diversity east of I-15 in the MSPA [26]. I-15 and urbanization are barriers to gene flow. Lions avoid grasslands; altered fire regime may type convert important habitats [27].	Focus educational outreach on measures to protect domestic animals from predation in communities with highest number of lion depredation permits and use movement data to design road construction and undercrossing projects to reduce lion deaths [25]. Maintain and enhance current connectivity across I-15 [26]. Monitor response of lions to increasing fire frequency [27]. Management recommendations from these studies have been included in MSP Roadmap objectives.	[25] Vickers et al. 2015; [26] Ernest et al. 2014; [27] Jennings et al. 2015