Central Valley Landscape Conservation Project

Climate Change Vulnerability Assessment (January 2017 version)

Yellow-billed Magpie

Vulnerability Assessment Summary

Overall Vulnerability Score and Components:

Vulnerability Component	**Score**
Sensitivity	Moderate
Exposure	Moderate-high
Adaptive Capacity	Moderate
Vulnerability	**Moderate**

Overall vulnerability of the yellow-billed magpie was scored as moderate. The score is the result of moderate sensitivity, moderate-high future exposure, and moderate adaptive capacity scores.

Key climate factors identified for yellow-billed magpies include precipitation amount and drought, which impact the species indirectly by affecting oak woodland habitat and abundance of invertebrate prey. Wildfire, disease, and grazing are key disturbance regimes for this species; they are particularly vulnerable to West Nile virus, which has a high mortality rate and has been linked to population declines. Wildfire and grazing primarily impact habitat quality, including oak (*Quercus* spp.) recruitment and acorn production.

Key non-climate factors for this species include urban/suburban development and land use change, which contribute to habitat loss and fragmentation. Landscape barriers include urban/suburban development, energy production and mining, and geologic barriers, all of which limit connectivity and gene flow.

This species exhibits moderate intraspecific species diversity; steep population declines associated with the West Nile virus make genetic bottlenecks a future possibility. This species has moderate resistance to climatic changes and human activities due to a combination of relatively low habitat/prey specialization and high disease mortality.

Management potential for yellow-billed magpies was scored as moderate-high. Management options may focus on limiting the loss and fragmentation of oak woodlands and encouraging the growth of large oaks that could provide nest sites.

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Introduction

Description of Priority Natural Resource

Yellow-billed magpies (*Pica nuttalli*) are endemic to California, found primarily in the Central Valley and central coastal regions (National Audubon Society 2013). They are year-round residents in the Central Valley, nesting in open oak woodlands and roosting in riparian and oak woodland habitats during cold periods (Verbeek 1972; Crosbie et al. 2006). Magpies fall within the corvid family, a group that also includes crows and ravens (*Corvus* spp.), and are closely related to the black-billed magpie (*Pica hudsonia*) (Crosbie et al. 2008); they are a USFWS bird species of conservation concern (DiGaudio et al. 2015). This species builds elaborate nests high in mature oak trees and breeds in loose colonies from March-May, with clutches typically consisting of 5-7 eggs. Yellow-billed magpies forage opportunistically, primarily for ground invertebrates, and collect acorns in the fall. Yellow-billed magpie populations have declined by over 73% since 1968, and they have a limited distribution within central California.

As part of the Central Valley Landscape Conservation Project, workshop participants identified the yellow-billed magpie as a Priority Natural Resource for the Central Valley Landscape Conservation Project in a process that involved two steps: 1) gathering information about the species' management importance as indicated by its priority in existing conservation plans and lists and 2) a workshop with stakeholders to identify the final list of Priority Natural Resources, which includes habitats, species groups, and species.

The rationale for choosing the yellow-billed magpie as a Priority Natural Resource included the following: the species has high management importance, the species' conservation needs are not entirely represented within a single priority habitat or species group, and the species is nearly endemic as well as considered an "emblematic species" for the region. Please see Appendix A: "Priority Natural Resource Selection Methodology" for more information.

Vulnerability Assessment Methodology

During a two-day workshop in October of 2015, 30 experts representing 16 Central Valley resource management organizations assessed the vulnerability of priority natural resources to changes in climate and non-climate factors, and identified the likely resulting pressures, stresses, and benefits (see Appendix B: "Glossary" for terms used in this report). The expert opinions provided by these participants are referenced throughout this document with an endnote indicating its source[1]. To the extent possible, scientific literature was sought out to support expert opinion garnered at the workshop. Literature searches were conducted for factors and resulting pressures that were rated as high or moderate-high, and all pressures, stresses, and benefits identified in the workshop are included in this report. For more information about the vulnerability assessment methodology, please see Appendix C: "Vulnerability Assessment Methods and Application." Projections of climate and non-climate change for the region were researched and are summarized in Appendix D: "Overview of Projected Future Changes in the California Central Valley".

Vulnerability Assessment Details

Climate Factors

Workshop participants scored the resource's sensitivity to climate factors and this score was used to calculate overall sensitivity. Future exposure to climate factors was scored and the overall exposure score used to calculate climate change vulnerability.

Climate Factor	Sensitivity	Future Exposure
Air temperature	Moderate	Moderate
Extreme events: drought	Moderate-high	High
Extreme events: more heat waves	-	Moderate-high
Increased wildfire	-	High
Precipitation (amount)	Moderate-high	Moderate
Overall Scores	**Moderate-high**	**Moderate-high**

The range of the yellow-billed magpie is expected to contract significantly, especially in the winter, with much of the Central Valley becoming moderately to highly unsuitable climatic habitat (National Audubon Society 2013). Only 20% of their current summer range will remain suitable (primarily in the foothills of the Sierra Nevada and Coast Range), and all of their current winter range will be lost. Overall, this species is expected to see a summer range contraction of 64% and a winter range contraction of 89% by 2080 (National Audubon Society 2013). Gardali et al. (2012) noted that climate-related exposure factors for yellow-billed magpies will include low food availability and exposure to extreme weather conditions.

Drought

> ***Sensitivity:*** *Moderate-high (high confidence)*
> ***Future exposure:*** *High (high confidence)*
> ***Potential refugia:*** *Refugia are readily available given the high behavioral plasticity and mobility of this species.*

Over the coming century, the frequency and severity of drought is expected to increase due to climate change (Hayhoe et al. 2004; Cook et al. 2015; Diffenbaugh et al. 2015; Williams et al.

2015), as warming temperatures exacerbate dry conditions in years with low precipitation, causing more severe droughts than have previously been observed (Cook et al. 2015; Diffenbaugh et al. 2015). Regardless of changes in precipitation, warmer temperatures are expected to increase evapotranspiration and cause drier conditions (Cook et al. 2015).

Recent studies have found that anthropogenic warming has substantially increased the overall likelihood of extreme California droughts, including decadal and multi-decadal events (Cook et al. 2015; Diffenbaugh et al. 2015; Williams et al. 2015).Riparian and oak woodland habitats may be more vulnerable to widespread tree mortality from "hotter droughts" over the coming century (Allen et al. 2015), and drought may also exacerbate the impacts of other factors (e.g., insects, pathogens, wildfire) and drive an increase in large-scale disturbance events (Millar & Stephenson 2015).

Precipitation (amount)

> ***Sensitivity:*** *Moderate-high (moderate confidence)*
> ***Future exposure:*** *Moderate (moderate confidence)*
> ***Potential refugia:*** *Refugia are readily available given the high behavioral plasticity and mobility of this species.*

Yellow-billed magpies are likely sensitive to changes in precipitation amount primarily through indirect impacts, including the availability of food resources. Invertebrate prey peaks in May, then declines throughout the summer dry period until its low point in September and October before fall rains arrive (Verbeek 1972). During the late summer, magpies gather in large flocks and range widely searching for food (Verbeek 1972).

Precipitation amount is also a primary climate factor in oak woodlands, and low annual precipitation may impede acorn production, seedling emergence and persistence, oak establishment (Tyler et al. 2006 and citations therein), and oak growth and distribution (Swiecki & Bernhardt 2006). Finally, changes in precipitation amount could impact disease transmission in this species, as mosquito populations are the main vector of West Nile disease (Crosbie et al. 2008).

Air temperature

Workshop participants did not further discuss this factor beyond assigning scores.

> ***Sensitivity:*** *Moderate (moderate confidence)*
> ***Future exposure:*** *Moderate (moderate confidence)*
> ***Potential refugia:*** *Refugia are readily available given the high behavioral plasticity and mobility of this species.*

Heat waves

Workshop participants did not further discuss this factor beyond assigning scores.

> ***Future exposure:*** *Moderate-high (moderate confidence)*
> ***Potential refugia:*** *Refugia are readily available given the high behavioral plasticity and mobility of this species.*

Climatic changes that may benefit the species:

Increased precipitation could result in an increase in healthy oak woodlands, which would benefit this species

Non-Climate Factors

Workshop participants scored the resource's sensitivity and current exposure to non-climate factors, and these scores were then used to assess their impact on climate change sensitivity.

Non-Climate Factor	Sensitivity	Current Exposure
Agriculture & rangeland practices	Moderate	Moderate
Land use change	Moderate-high	Low-moderate
Pollution & poisons	Moderate	Low-moderate
Roads, highways, & trails	Low-moderate	Low
Urban/suburban development	Moderate-high	Low-moderate
Overall Scores	**Moderate**	**Low-moderate**

Urban/suburban development

Sensitivity: *Moderate-high (high confidence)*
Current exposure: *Low-moderate (high confidence)*
Pattern of exposure: *Localized; magpies are behaviorally adaptive so they can move to other places.*

Yellow-billed magpies may roost in urban areas, especially in or near riparian areas (Crosbie et al. 2006). They can roost in cultivated species such as glossy privet (*Ligustrum lucidum*), English ivy (*Hedera helix*), and white mulberry (*Morus alba*) in addition to native oaks (*Quercus* spp.) and California laurel (*Umbellularia californica*) (Crosbie et al. 2006). However, development has contributed to the loss and fragmentation of oak woodlands in the Central Valley (Bolsinger 1988), and continued development pressure in the foothills may impact both habitat quality and availability (Spero 2002; Grivet et al. 2008).

Land use change

Sensitivity: *Moderate-high (high confidence)*
Current exposure: *Low-moderate (high confidence)*
Pattern of exposure: *Localized.*

Loss of habitat has likely contributed to the decline of yellow-billed magpie populations, as well as historical range contraction (Koenig & Reynolds 2009).

Workshop participants did not further discuss the following factors beyond assigning scores.

Agricultural & rangeland practices

Sensitivity: *Moderate (high confidence)*
Current exposure: *Moderate (high confidence)*
Pattern of exposure: *Variable by crop types.*

Pollution & poisons

Sensitivity: *Moderate (low confidence)*
Current exposure: *Low-moderate (high confidence)*
Pattern of exposure: *Highly variable, depending on local practices.*

Roads, highways, & trails

Sensitivity: *Low-moderate (moderate confidence)*
Current exposure: *Low (high confidence)*
Pattern of exposure: *Widespread across the landscape.*

Disturbance Regimes

Workshop participants scored the resource's sensitivity to disturbance regimes, and these scores were used to calculate climate change sensitivity.

Overall sensitivity to disturbance regimes: *Moderate-high (moderate confidence)*

Disease

Sensitivity: *High (high confidence)*
Pattern of exposure: *Localized (low confidence)*

Yellow-billed magpie populations have been heavily impacted by the West Nile virus (WNV) since 2004 (Ernest et al. 2010), and 81% of dead magpies submitted to the California Dead Bird Surveillance Program that year tested positive for the virus (Crosbie et al. 2008). A sharp decline in yellow-billed magpie populations coincided with the discovery of WNV in California (Crosbie et al. 2008), suggesting that there may be a strong relationship between the two. Mosquitos are the primary vector of WNV, and the range of yellow-billed magpies falls fully within the range of prime mosquito vector habitat (mainly *Culex* spp.), leaving the entire population vulnerable to infection (Crosbie et al. 2008; Ernest et al. 2010). In yellow-billed magpies, the disease seems to have a rapid onset and very high mortality rates (Ernest et al. 2010).

Wildfire

Exposure: *High (high confidence)*

Potential refugia: *Refugia are readily available given the high behavioral plasticity and mobility of this species.*

Yellow-billed magpies are vulnerable to wildfire both directly (e.g., nest destruction) and indirectly, through impacts to oak woodland habitat. While mature oaks are fairly resilient to fire, oak seedlings and saplings experience topkill (often followed by resprouting) or complete mortality (Swiecki & Bernhardt 1998; Holmes et al. 2008). Frequent fire may inhibit oak regeneration and increase mortality (Swiecki & Bernhardt 1998), but also may promote lower fire severity by maintaining lower fuel loads (Holmes et al. 2008). In general, smaller trees, higher fuel loads, and hotter fires are detrimental to oak woodland fire resilience (Holmes et al. 2008).

Grazing

Tewksbury et al. (2002) found, in a study of riparian habitats in the western United States, that open nesters, a group that includes yellow-billed magpies, were significantly more abundant in ungrazed locations compared to grazed areas. Grazing may impact the species by altering oak woodland habitats by negatively impacting oak recruitment and growth (Swiecki & Bernhardt 1998; Tyler et al. 2006).

Life history and reproductive strategy

Workshop participants scored the resource's life history and reproductive strategy, and these scores were used calculate climate change sensitivity.

Species reproductive strategy, representing generation length and number of offspring*: Mid-range reproductive strategy (high confidence)*
Average length of time to reproductive maturity: *2 years*

The breeding season for yellow-billed magpies is from March until May, coinciding with the period of time in which invertebrates are most abundant and temperatures are warm enough to minimize the amount of energy that must be supplied through foraging activity (Verbeek 1972). Nest-building occurs over the course of many weeks, and nests consist of large domes comprised of sticks that are placed high in mature oak trees (Verbeek 1972; Crosbie et al. 2006). Breeding occurs in loose colonies and extra-pair courtship is relatively common in this species (Birkhead et al. 1992). Male magpies guard their partners during and after copulation and until the first egg is laid (Birkhead et al. 1992), then are solely responsible for feeding females during incubation (Verbeek 1972). Clutches typically consist of 5-7 eggs and the entire nesting period is ~55 days from egg laying until fledging (Verbeek 1972). Territories are maintained year-round, primarily through posturing and conspicuous perching (magpies do not sing); territory establishment typically occurs in early fall when the hatch-year birds disperse and try to establish themselves into a colony (Verbeek 1972).

Dependency on habitat and/or other species

Workshop participants scored the resource's dependency on habitat and/or other species, and these scores were used calculate climate change sensitivity.

> ***Overall degree of specialization****: Moderate (high confidence)*
> ***Dependency on one or more sensitive habitat types:*** *Low-moderate (high confidence)*
> ***Dependency on specific prey or forage species:*** *Moderate (high confidence)*
> ***Dependency on other critical factors that influence sensitivity:*** *Moderate (low confidence)*

Yellow-billed magpies forage for invertebrates on the ground and are not considered habitat or prey specialists (Verbeek 1972; Gardali et al. 2012). They use a relatively wide variety of habitat types (Gardali et al. 2012), although oak woodlands are particularly important (Koenig & Reynolds 2009). Yellow-billed magpies collect acorns in the fall (Verbeek 1972), and acorn production is highly variable on an interannual, site, and species basis (Tyler et al. 2006).

Adaptive Capacity

Workshop participants scored the resource's adaptive capacity and the overall score was used to calculate climate change vulnerability.

Adaptive Capacity Component	Score
Extent, Status, and Dispersal Ability	Moderate-high
Landscape Permeability	Moderate
Intraspecific Species Diversity	Moderate
Resistance	Moderate
Overall Scores	**Moderate**

Extent, status, and dispersal ability

> ***Overall degree of extent, integrity, connectivity, and dispersal ability:*** *Moderate (high confidence)*
> ***Geographic extent:*** *Occurs beyond small area but still quite limited (high confidence)*
> ***Health and functional integrity:*** *Moderately healthy (high confidence)*
> ***Population connectivity:*** *Continuous with some breaks (moderate confidence)*
> ***Dispersal ability:*** *High (high confidence)*
> ***Maximum annual dispersal distance of species:*** *75-100 km (moderate confidence)*

Yellow-billed magpies are endemic to California, found primarily in the Central Valley and central coastal regions (National Audubon Society 2013). Their total range is roughly 82,000-88,700 km^2 depending on the season (National Audubon Society 2013), and their home ranges typically cover 0.4 km^2 (40 ha.; Verbeek 1972). In the late summer when food resources are low, magpies gather in large flocks and range over an area of about 60 km^2 (600 ha.) to forage (Verbeek 1972). The vulnerability of this species is probably not impacted by dispersal ability, which is relatively average (Gardali et al. 2012), but they are impacted by habitat loss and fragmentation (Koenig & Reynolds 2009).

Yellow-billed magpie populations declined 73% between 1968 and 2014 at an average rate of 1.9-2.7% per year (North American Bird Conservation Initiative, U.S. Committee 2014; Sauer et al. 2014), and the global breeding population is estimated to be around 90,000 (Partners in Flight Science Committee 2013). Population declines have been particularly rapid over the past decade, which likely connected to the onset of the West Nile virus (Crosbie et al. 2008; Ernest et al. 2010).

Landscape permeability

Overall landscape permeability: *Moderate (moderate confidence)*

Impact of various factors on landscape permeability:

Urban/suburban development: *Moderate (moderate confidence)*

Energy production & mining: *Moderate (moderate confidence)*

Geologic features: *Low-moderate (low confidence)*

Yellow-billed magpies effectively function as an "island species" because they have a limited distribution surrounded by unsuitable habitat (e.g., mountains) that leaves little or no room for range shifts (Ernest et al. 2010). There is relatively little information available on the response of yellow-billed magpies to landscape barriers, although they are known predators of tricolored blackbirds (*Agelaius tricolor*) and predation may occur more often in areas impacted by human activity (Payne 1969; Belenky & Bond 2014). They are not vulnerable to brood parasitism by brown-headed cowbirds (*Molothrus ater*), which is a frequent cause of population decline associated with increased urban and agricultural development for other bird species (Tewksbury et al. 2002).

Species diversity

Overall species diversity: *Moderate (moderate confidence)*

Diversity of life history strategies: *Moderate-high (high confidence)*

Genetic diversity: *Low-moderate (moderate confidence)*

Behavioral plasticity: *Moderate-high (high confidence)*

Phenotypic plasticity: *Low-moderate (low confidence)*

High mortality from the West Nile virus, combined with the limited range and rapidly declining populations of this species put it at risk of a bottleneck event (Ernest et al. 2010).

Resistance

Resistance to stresses/maladaptive human responses: *Moderate (moderate confidence)*

Although there is little evidence of physiological sensitivity to climate conditions (Gardali et al. 2012), declining populations and a limited range likely detract from the ability of this species to adapt to climate and non-climate-related factors.

Management potential

Workshop participants scored the resource's management potential.

Management Potential Component	Score
Species value	Moderate-high
Societal support	Low-moderate
Agriculture & rangeland practices	Moderate-high
Extreme events	Moderate
Converting retired land	Moderate-high
Managing climate change impacts	Moderate-high
Overall Score	**Moderate-high**

Value to people

Value to people: *Moderate-high (moderate confidence)*

Support for conservation

Degree of societal support for management and conservation: *Low-moderate (moderate confidence)*

Degree to which agriculture and/or rangelands can benefit/support/increase resilience: *Moderate-high (moderate confidence)*

Degree to which extreme events (e.g., flooding, drought) influence societal support for taking action: *Moderate (low confidence)*

Likelihood of converting land to support species

Likelihood of (or support for) converting retired agriculture land to maintain or enhance species: *Moderate-high (moderate confidence)*

Likelihood of managing or alleviating climate change impacts: *Moderate-high (high confidence)*

Management options for this species may focus on limiting habitat loss and fragmentation at multiple spatial scales to enhance connectivity and gene flow among isolated populations (Huber et al. 2010). Future climate conditions, especially reduced precipitation and/or drought, may impact oak recruitment and acorn production, and land management actions geared towards maintaining soil moisture, minimizing cattle grazing, and maintaining genetic diversity in oak plantings may increase the availability of nest sites and acorns for yellow-billed magpies (Hall et al. 1992; Swiecki & Bernhardt 1998). Protecting riparian areas and topographical diversity may also help maintain drought refugia for oak species (McLaughlin & Zavaleta 2012; McLaughlin et al. 2014).

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