Assessment of Willowy Monardella Status, Habitat, and Threats on Conserved Lands in San Diego County

Presentation for the September 2022 SDMMP Management and Coordination Meeting

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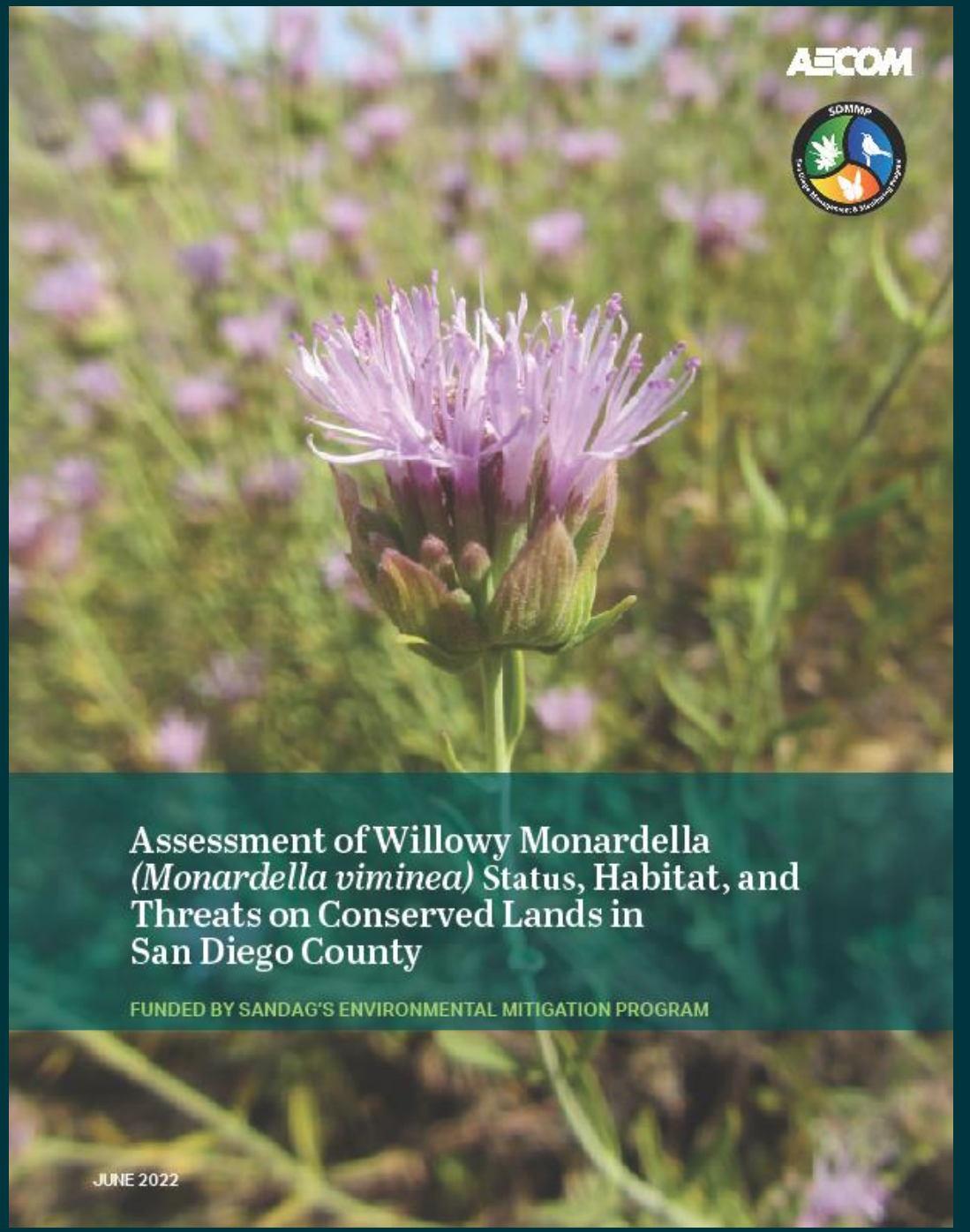

Overview

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Purpose – Project Background

The F-RPMP released in 2021 included a species-specific management plan for willowy monardella that recommends a framework for managing known populations and identifies the following information needs, within conserved lands:

1. Identify locations that contain suitable habitat for willowy monardella to be introduced into.
2. Develop hydrology models based on analysis of locations where monardella exists to identify which areas of suitable habitat have hydrology most conducive to the establishment and survival of willowy monardella.
3. Identify sites where willowy monardella has been extirpated but would be suitable for reintroduction.

Species Background – Natural History

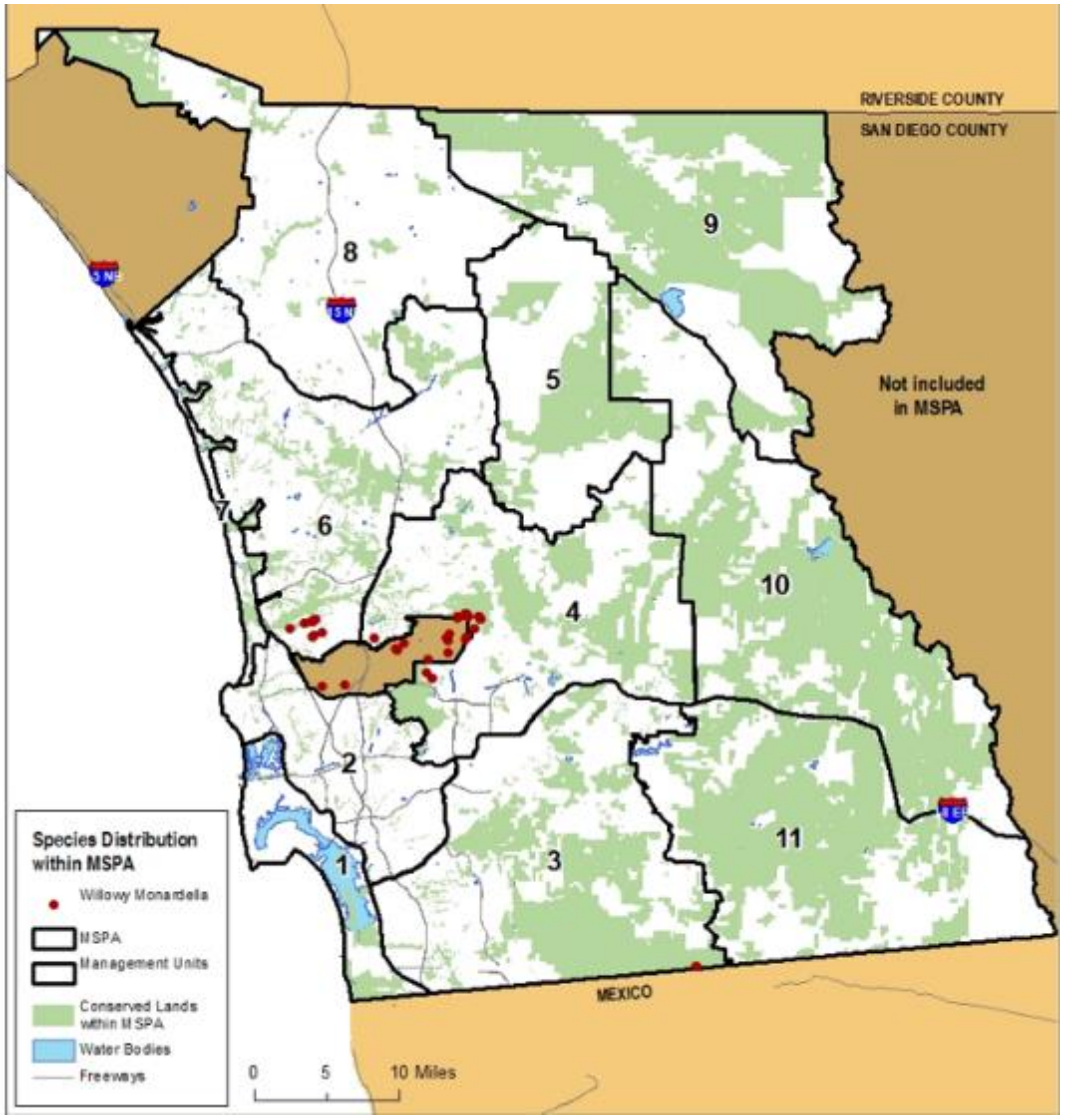
Willowy monardella's present range is restricted to drainages within canyon systems of the following three main watersheds in San Diego County (SDNHM 2021):

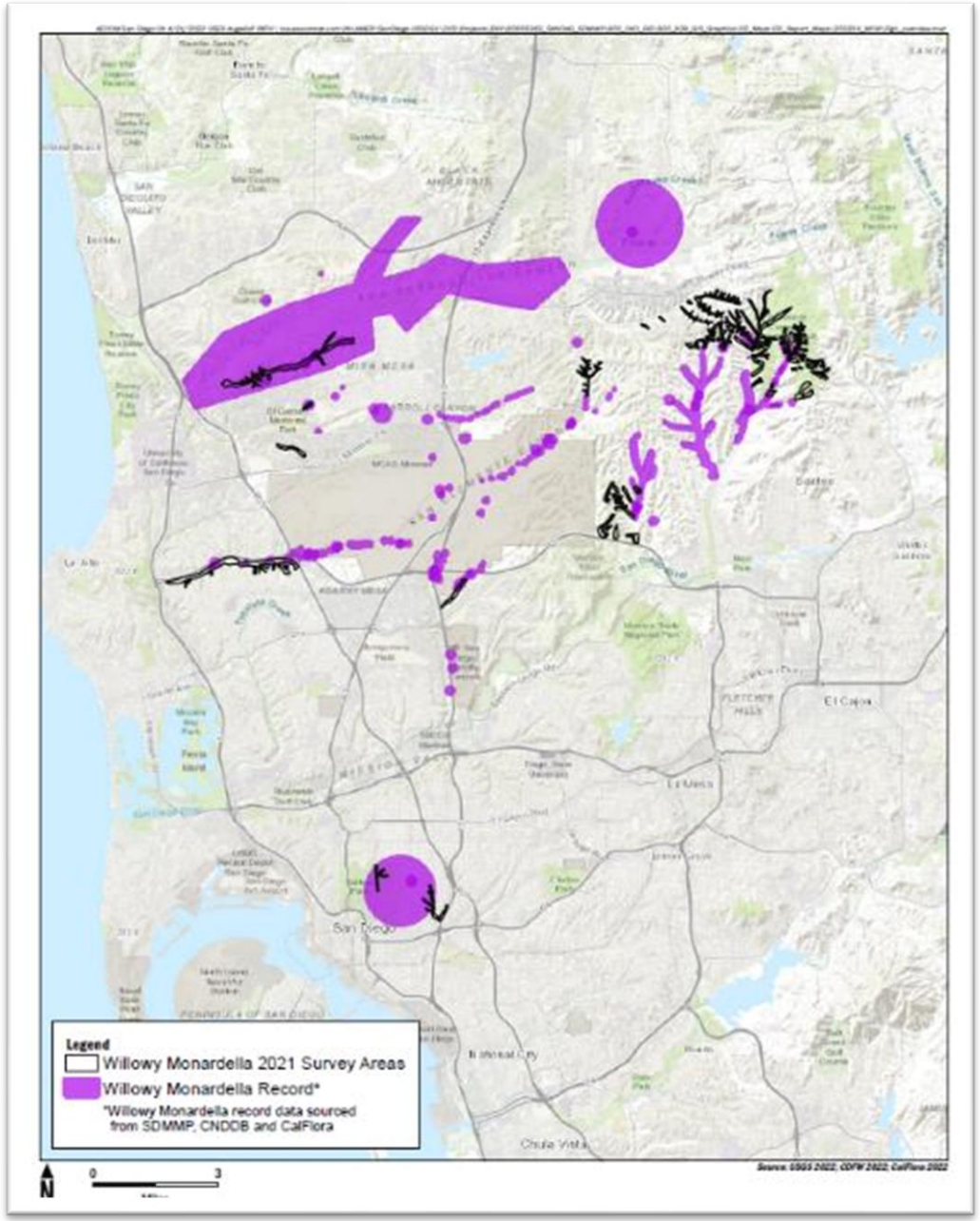
- Peñasquitos watershed, which includes Mission Bay, La Jolla, most of Marine Corps Air Station (MCAS) Miramar, and Poway.
- San Diego River watershed, which includes the San Diego River and its tributaries, the southwestern portion of MCAS Miramar, and extends as far east as Julian.
- Pueblo watershed, which includes downtown San Diego, National City, and La Mesa .

Species Description

Willowy monardella is a perennial species in the mint family (Lamiaceae). This aromatic subshrub typically spreads by underground runners and grows in dense clumps, tufts, or in a mat-like form with stems typically 25-50 cm (10-20 in) in length. Often times, willowy monardellas's growth habit makes differentiating individual plants difficult. The white to lavender- or rose-colored flowers occur in terminal clusters as a panicle, and clusters are subtended by whorls of bracts that are greater in length than the calyx (Sanders, Elvin, and Burnell 2012). Each flower produces up to four smooth, brown, ovoid seeds that are less than 1.9 mm long (Epling 1925, Elvin and Sanders 2009). The lifespan for willowy monardella is not fully understood; however, the species is presumed to be long-lived with clumps know to be in existence since 1993 (Burrascano 2020).

Species Range and Survey Areas





Survey Area Prioritization

Canyon System	Priority	No. of Survey Areas
34th Street	Medium	12
Beeler	High	32
Carroll	High	1
Elanus	High	1
Flannery	High	1
Los Peñasquitos (Lopez)	High	15
Marian Bear	High	11
Spring Canyon	High	12
Switzer	High	1
Upper San Clemente	High	12
Upper Sycamore/Upper West Sycamore/Clark	High	95
Del Mar Mesa	Medium	1
Florida	Medium	2
Oak Canyon	Medium	8
Slaughterhouse	Medium	15
Iron Mountain	Low	–
South Poway	Low	–
Total Survey Polygons:		219

Canyon systems included in the project were selected within **conserved lands** based on the location and presence of extant and historical subpopulations.
Canyon systems within the larger project area were assessed and **ranked as either high, moderate, or low priority** areas to receive species surveys.

- **High** - canyon systems with extant subpopulations, currently monitored/monitoring plots established, adjacent to and share channels farther downstream with known subpopulations.
- **Moderate** - canyon systems with historical occurrences have been recorded but mapping unknown/unverified, includes adjacent canyons.
- **Low** - canyons in proximity of extant populations but not located within the same local watershed or lacking connectivity to known extant populations (i.e., were not connected either upstream or downstream to an occupied canyon system).

Species Background – Existing Data and Past Studies

Most studies pertaining to the population status, life history, and effects of different management strategies have been performed within MCAS Miramar, which contains 70% of the existing willowy monardella population.

The following studies were referenced in the development if this study:

- 2002, 2009, 2012, 2013, 2017: Comprehensive species census on MCAS Miramar (not conserved land).
- 2003, 2004 – 2006, 2015: establishment and monitoring of sample plots on MCAS Miramar (not conserved land).
- 2006: Carroll Canyon Business Park translocation project.
- 2006: Los Penasquitos hydrology study.
- 2009 – 2011: Habitat enhancement study.
- 2016 – 2022: Annual IMG monitoring on conserved lands.

Species Background – Known Threats

Table 4.7-12. Willowy Monardella: Management Priorities.[1]

MSP Occurrence	Size[2]	Threats[3,4]																				GN[5]	RP[6]
		AH	BR	CNP	D/T	ER	FP	FM	HE	HA	HG	NNF	NNG	O/M	RF	RC	SM	SC	TR	TP	VC	OT	RE	RS
MOLIV_4SYCA001	Small	H	---	---	---	M	---	---	---	H	---	M	M	---	H	---	---	---	---	---	---	---	H	H
MOLIV_4SYCA002	Small	H	---	H	---	M	---	---	---	---	---	H	H	---	H	---	---	---	L	---	---	---	H	H
MOLIV_4WSCA003	Small	H	---	---	---	H	---	---	---	---	---	H	H	---	---	---	---	---	L	---	---	H	H	H
MOLIV_6LOCA004	Small	H	---	---	L	H	---	---	---	---	---	H	H	---	---	---	---	---	L	---	---	---	H	H
MOLIV_4SYCA006	Medium	H	---	L	L	H	---	---	L	---	---	H	H	L	H	---	L	---	M	L	---	L	L:	M
MOLIV_6FLCA007	Small	H	---	L	L	H	---	---	---	---	---	L	L	---	---	---	---	---	---	---	---	L	H	H
MOLIV_4SPCA008	Small	H	---	L	L	M	---	---	---	---	---	L	M	---	H	---	---	---	L	---	---	L	H	H

1 Management Priorities: **L** = Low Priority, **M** = Medium Priority, **H** = High Priority. If no priority level is indicated, then no management action is recommended at this time. Monitor occurrences with no data (---) per the IMG protocol to identify and recommend appropriate management actions.

2 Size = population size category: **large** = >10,000 plants, **medium** = 1,000-10,000 plants; **small** = <1,000 plants.

3 Threat Categories: **AH** = Altered Hydrology, **BR** = Brush Management, **CNP** = Competitive Native Plants, **D/T** = Dumping/Trash, **ER** = Erosion, **FP** = Feral Pigs, **FM** = Fuel Modification, **HE** = Herbivory, **HA** = Historic Agriculture, **HG** = Historic Grazing, **NNF** = Nonnative Forbs, **NNG** = Nonnative Grasses, **O/M** = Off-road Vehicles/Mountain Bikes, **RF** = Recent Fire, **RC** = Road Construction, **SM** = Slope Movement, **SC** = Soil Compaction, **TR** = Trails, **TP** = Trampling, **VC** = Vegetation Clearing, **OT** = Other (refer to full IMG data for description of other threats at each occurrence).

4 Threats per IMG monitoring protocol. --- = no data (occurrence not monitored per IMG monitoring protocol).

5 **GN** = Genetics; **RE** = Reintroduce plants using seed from the target occurrence (if an adequate amount of seed is available) or from a genetically compatible seed source within the same population group (genetic cluster). We do not include recommendations for occurrences with no monitoring data.

6 **RP** = Regional Population Structure; **RS** = Restore habitat (enhance, expand). We do not include recommendations for occurrences with no monitoring data.

- Fossorial mammal species
- Non-native forbs
- Non-native grasses
- Urban runoff
- Altered hydrology

Species Background – Natural History (cont.)

- Drainage Structure
  - Width
  - Braiding
  - Presence of standing water
- Channel Characteristics
  - Alluvial bench presence and width
  - Substrate texture
- Associated Vegetation
  - Open or unvegetated
  - Presence of coastal sage scrub species

Methods – Survey Protocol

Data Form Development

A form was developed to collect data on suitable habitat based on factors that were identified as potentially significant willowy monardella habitat quality indicators during previous studies of the species and the known life history and biology.

Habitat Suitability Features

- Vegetation Communities
- Landform/Terrain Characteristics
- Hydrology
- Soils and Substrates
- Assessment of Potential Threats

Field Surveys Methods

Field surveys were conducted during the 2021 blooming season for willowy monardella (May through July). Biologists visited high and moderate priority survey areas and determined whether potential habitat existed. If *no potential habitat* was observed, notes were recorded to document the decision. *If potential habitat was observed* within the survey area, it was mapped using a line feature on ArcCollector, and a habitat suitability assessment data was collected.

Data Form Specifics

Survey Area ID	Survey Date	Survey Start Tin	Does the Survey Area contain habitat suitable for MOLIV?	If no, Why is the Survey Area unsuitable?	Other Commen	evaluated, why was the site not	unoccupie habitat to photograp
thStCynA	6/14/2021 19:00	12:27	Yes				Yes
thStCynB	6/14/2021 19:00	12:09	No	Substrate,Channel,AlluvialBenches			
thStCynH	6/14/2021 19:00	11:22	No	Channel,Other	Narrow and undercut.		
thStCyn				trate,Channel			
thStCyn				nel,Alluvial hes			
thStCyn							Yes

Willowy Monardella Data Form

Survey Information

Survey Area ID (dropdown or surveyors to type in, depending on lead time provided to Emily [AECOM still needs to split up Survey Areas and assign IDs])
Surveyors Drop down
Affiliation: AECOM
Land Owner (fill out post-field survey, via desktop)
Management Unit (fill out post-field survey, via desktop)
Date (auto-populate with option to edit)
Time Start (auto-populate with option to edit)
Does the Survey Area contain habitat suitable for MOVI? Y/N; Not Evaluated

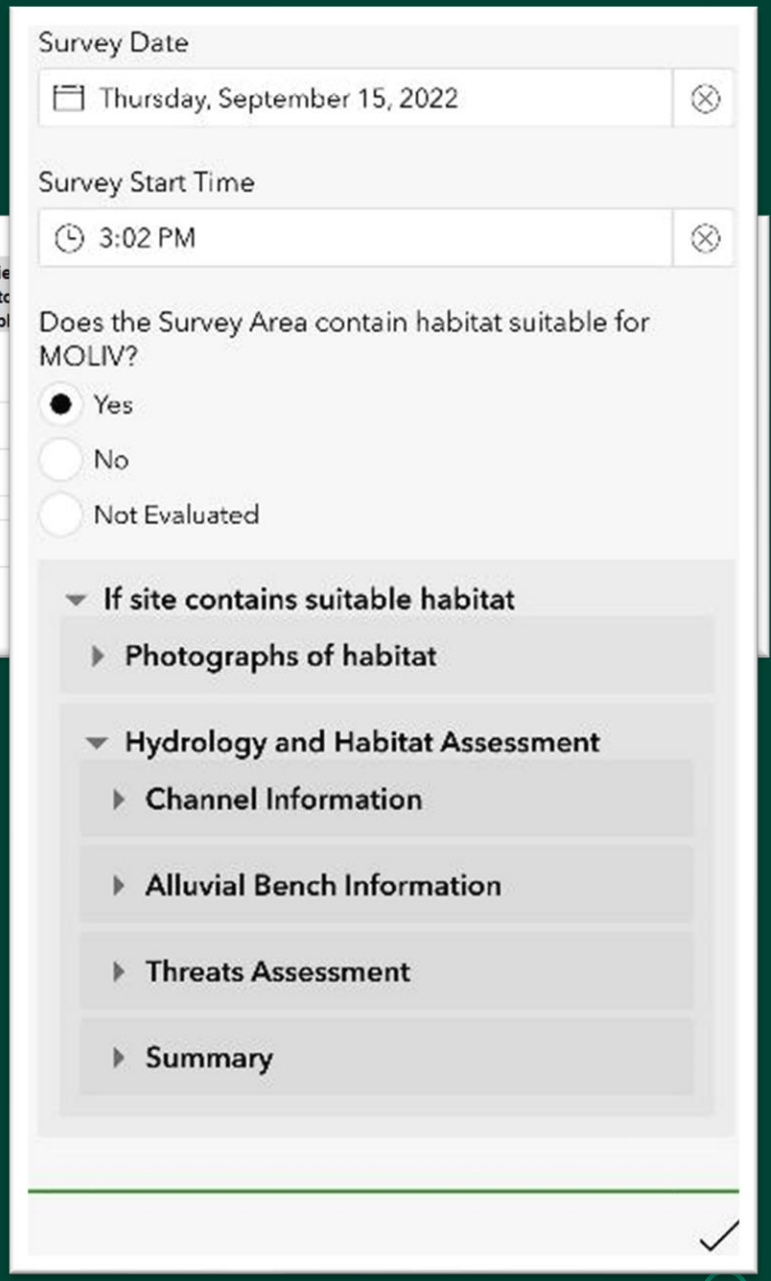
If Not Evaluated, notes for why (access constraints, etc.)

If No, **Why is the Survey Area Unsuitable?** (select all that apply, but checking one would disqualify the Survey Area as Suitable)

- Unsuitable substrate (no cobbles or sand)
- No open/wide/or braided channel *and* No sandy/alluvial benches present
- Other
    - Option for comments

If Yes, **fill** out data below:

Photographs of Unoccupied Suitable Habitat (Option for up to 8 Photo Points)



Data Collection Attributes

Landform/Terrain

Drainage classifications

- Primary
- Secondary

- Average Channel Width
  - OHWM width and depth

- Alluvial Bench
  - Average alluvial bench width
  - % of channel with alluvial bench
  - Each side of channel accounts for 50%, so a channel with alluvial bench only occurring along ½ of one side would have 25%

Vegetation Communities

Channel vegetation and alluvial bench vegetation estimated visually to determine:

- % Native cover
- % Non-native cover
- % Other cover (e.g. that, litter, cryptogamic crust, etc.

*Species greater than 20% cover were considered “dominant”

Data Collection – Cont.

Soils and Substrates

Substrate compositions collected for both channel and alluvial benches by percent composition totaling 100%:

- Boulders
- Cobbles
- Gravel
- Sands/Fines

Threats Assessment

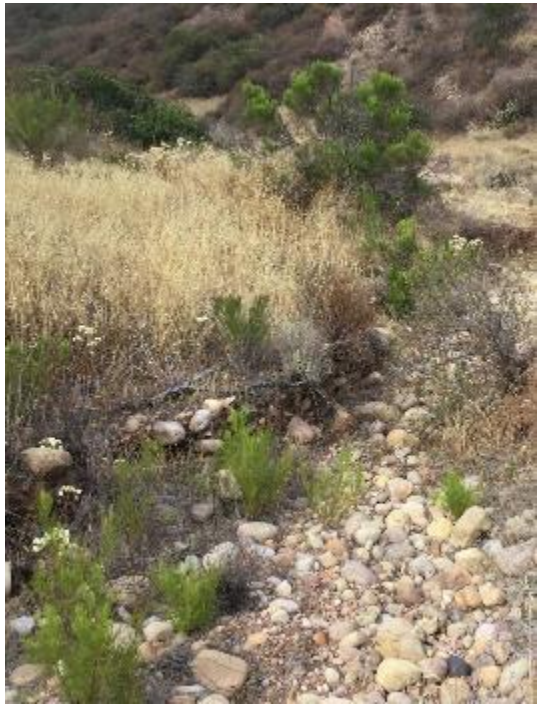
Utilized the IMG monitoring protocol threats assessment

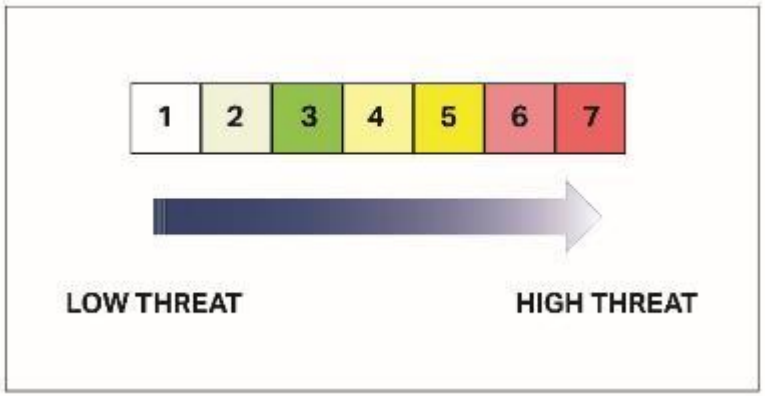
- 23 different threats
- Scale of 1-7

Hydrology

Assessment was based on the California Rapid Assessment Method (CRAM) for episodic riverine systems (CMWM 2020). Focused on the following parameters:

- Indicators of Natural Processes
- Indicators of Altered Sediment Transport



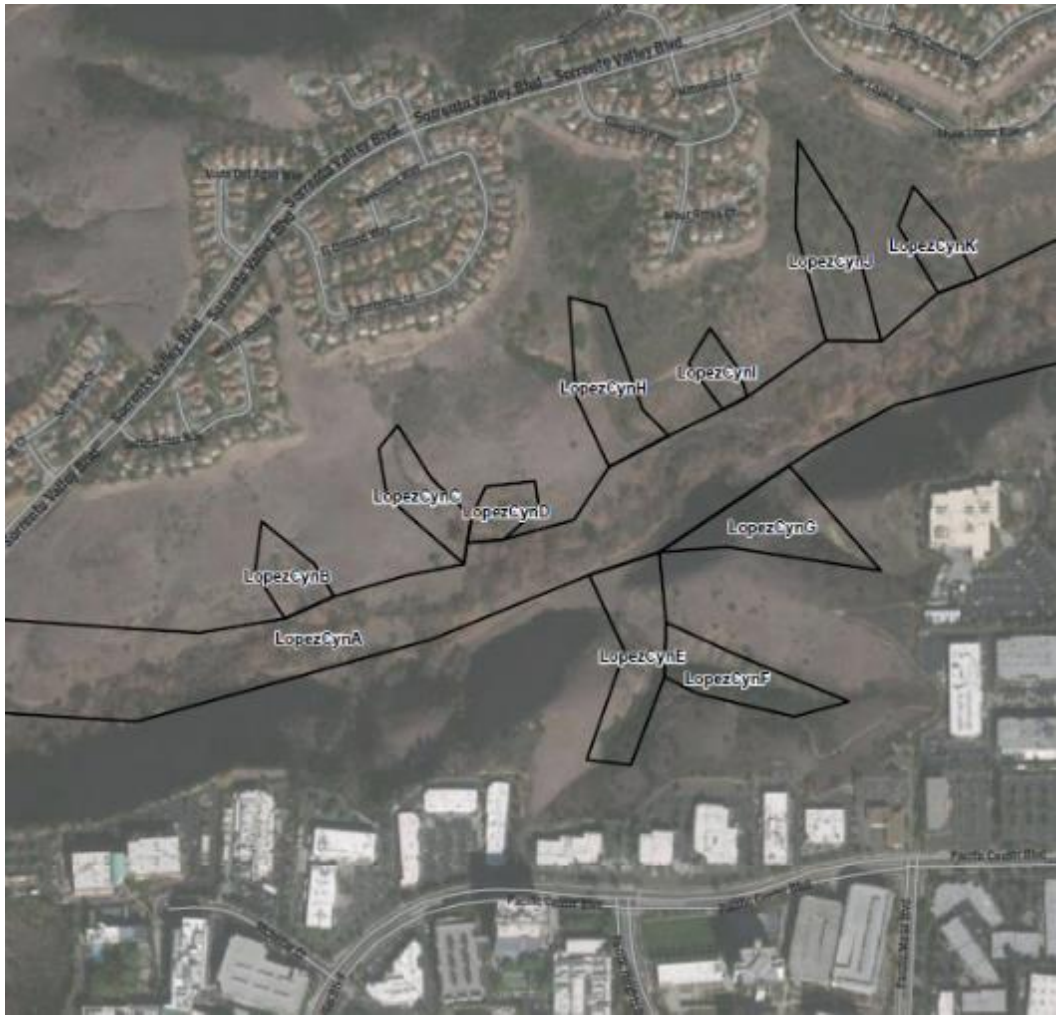


Non-suitable Habitat

Exclusion of Non-Suitable Habitat:

- Lack of suitable substrate (e.g., no change in sediment size in channel from surrounding areas or entirely fine material)
- Lack of alluvial benches
- Channel width less that 1 meter
- Topography (deeply incised canyons)

Of the 219 survey areas, 176 were determined unsuitable.



Results – Suitable Habitat

Suitable Canyons

- Of the 219 surveyed canyons, 43 were determined to be suitable
- Of the 43 suitable survey areas
  - 34 unoccupied (expected to have a wider range of values)
  - 9 occupied

Mapping

- Suitable habitat was mapped as a line along the length of the drainage
- If suitable habitat was non-contiguous within the line, the line was not stopped and re-started
- Only one line per canyon

Results – Channel Characteristics

Channel Characteristics in Unoccupied Habitat

Channel Characteristic		Average value
Average depth at OHWM (cm)		39.0
Max depth (cm)		93.9
Average channel width (m)		1.8
Substrate composition (%)	Boulder	4.9
	Cobble	47.0
	Gravel	40.0
	Sand	7.5
	Fines	0.6

Channel Characteristics in Occupied Habitat

Channel Characteristic		Average value
Average depth at OHWM (cm)		59
Max depth (cm)		99.4
Average channel width (m)		3.8
Substrate composition (%)	Boulder	5.9
	Cobble	46.3
	Gravel	42.9
	Sand	5.0
	Fines	0.3

Differences in Channel Characteristics between Occupied and Unoccupied Habitat

- Wider average channel width
- Higher average depth of OHWM

Results – Alluvial Bench Characteristics

Alluvial Bench Characteristics in Unoccupied Habitat

Bench Characteristic		Average Value
Average width of alluvial bench (m)		7.0
Average percent of channel with alluvial benches (%)		64.6
Average ratio of channel to bench		1:1
Avg. Substrate composition (%)	Boulder	1.2
	Cobble	15.3
	Gravel	21.0
	Sand	35.6
	Fines	25.1

Alluvial Bench Characteristics in Occupied Habitat

Bench Characteristic		Average Value
Average width of alluvial bench (m)		14.4
Average percent of channel with alluvial benches (%)		80.0
Average ratio of channel to bench		4:5
Avg. Substrate composition (%)	Boulder	0.5
	Cobble	23.4
	Gravel	20.6
	Sand	32.1
	Fines	20.1

Differences in alluvial bench characteristics between Unoccupied and Occupied habitat:

- Average width of occupied benches were twice as wide
- Occupied alluvial benches were more evenly distributed along channel
- Higher cobble and gravel and lower sand/fines in occupied habitat

Results – Vegetation

Average Vegetation Cover in Unoccupied Habitat

Cover Type	Channel	Alluvial Bench
Cover Native (%)	8.7	30.1
Cover Nonnative (%)	6.1	34.1
Cover "other"(%)	0.1*	3.3**
Total	**14.9**	**67.5**

*Thatch only. Results from Marian Bear A were excluded from the analysis, as they were highly atypical (79% cover of standing water in the channel).
**Thatch, floodborne woody debris and dead shrubs.

Greater vegetation cover in unoccupied habitat

Average Vegetation Cover in Occupied Habitat

Cover Type	Channel	Alluvial Bench
Cover Native (%)	3.1	38.8
Cover Nonnative (%)	2.7	39.3
Cover "other"(%)	0.1*	3.5**
Total	**5.9**	**81.6**

*Plant litter
**Thatch

Results – Channel Stability and Sediment Transport

Summary of Channel Stability Indicators in Unoccupied Habitat

Criteria	Number of Drainages
Indicators of channel stability/equilibrium	
Distinct soil texture and grain size differences between different parts of the drainage	25
Channels contain embedded woody debris of the size and amount consistent with the adjacent area	23
Channel bars consist of well-sorted bed material	8
Channel is well defined	33
Channel has braided compound channels	12
There is a high density of channels	–
Number of indicators of channel stability recorded in drainages	
One indicator	2
Two indicators	8
Three indicators	13
Four or more indicators	11
Indicators of altered sediment processes	
Channel is characterized by steep or undercut banks	12
An obvious historical floodplain has been abandoned	2
The channel is scoured to bedrock or dense clay in places	3
Soil texture and grain size differences between the low flow channel and floodplain are not evident or distinct	9
The channel is ill defined	1
Several previously distinct channels have coalesced	–
Channel bed and bars (if present) are not well sorted but rather a homogenized mix of grain sizes	6
Number of indicators of altered sediment processes recorded in drainage	
No indicators	12
One indicator	10
Two indicators	11
Three indicators	1
Four or more indicators	–

Summary of Channel Stability Indicators in Occupied Habitat

Criteria	Number of Drainages
Indicators of channel stability/equilibrium	
Distinct soil texture and grain size differences between different parts of the drainage	7
Channels contain embedded woody debris of the size and amount consistent with the adjacent area	4
Channel bars consist of well-sorted bed material	6
Channel is well defined	8
Channel has braided compound channels	3
There is a high density of channels	3
Number of indicators of channel stability recorded in drainages	
Two indicators	1
Three indicators	–
Four indicators	4
Five Indicators	1
Six indicators	3
Indicators of altered sediment processes	
Channel is characterized by steep or undercut banks	3
An obvious historical floodplain has been abandoned	–
The channel is scoured to bedrock or dense clay in places	–
Soil texture and grain size differences between the low flow channel and floodplain are not evident or distinct	–
The channel is ill defined	–
Several previously distinct channels have coalesced	–
Channel bed and bars (if present) are not well sorted but rather a homogenized mix of grain sizes.	1
Number of indicators of altered sediment processes recorded in drainage	
No indicators	4
One indicator	4
Two indicators	–
Three indicators	–
Four or more indicators	–

Reminder that there are 34 unoccupied and 9 occupied, so we are looking at categories and thresholds rather than volume

What should we be looking for in “high quality” habitat?

Channel Stability

- 3-4 indicators of stability
- 1 or fewer indicators of altered sediment transport

Channel Characteristics

- Relatively wide OHWM greater than 2 meters
- Moderate OHWM depth between 20-60 centimeters
  - Shallower likely represents low volume areas
  - Deeper likely represents erosion and too high of velocity

Alluvial Benches

- Well distributed alluvial benches over 50% of channel
- Alluvial benches over 10 meters in width
- Cobbles or gravel composition greater than 40%
  - Occupied areas rarely exceeded total of 60% for cobble and gravel combined

Vegetation and Dominant Species

- Did not appear strongly correlated
- Occupied habitats generally had less than 50% non-native cover on benches
- Native plant species less than 5% in channel (lower cover overall)

Creating Habitat Scoring

11 data fields that informed the most relevant components of high-quality habitat

↓

"**lumped**" into 3-4 ranges

↓

Assigned **Values**

↓

Weighted by apparent strength of correlation

Description of Habitat Component	Scoring	Score
Indicators of Channel Stability (based on CRAM methodology) present	4+ Indicators of channel stability, 1 or fewer indicators of altered sediment transport	8
	3 indicators of channel stability, 1 or fewer indicators of altered sediment transport, or 4+ indicators and 1+ indicators of altered sediment transport	5
	3 indicators of channel stability, more than 1 indicator of altered sediment transport	3
	2 or less indicators of channel stability	0
Average width of alluvial benches	Average alluvial bench width 10+ m	8
	Average alluvial bench width ≥3-<10 m	4
	Average alluvial bench width <3 m	0
Percent boulder, cobble, gravel, sand, silt on the alluvial benches	Boulder cobble, gravel make up ≥40%-60% of substrate	6
	Boulder, cobble, gravel make up <40% of substrate	4
	Boulder, cobble, gravel make up ≥60% of substrate	1
Percentage of channel bank with alluvial benches present	90-100% of channel has an alluvial bench	6
	50-90% of channel has an alluvial bench	3
	<50% of channel has an alluvial bench	0
Percent cover of native plants on alluvial bench	Native cover 20-50%	6
	Native cover >50%-≤70%	3
	Native cover <20% or >70%	0
Percent boulder, cobble, gravel, sand, silt in the bottom of channel	Boulder, cobble, gravel make up ≥95% of substrate	4
	Boulder, cobble, gravel make up ≥90-<95% of substrate	3
	Boulder cobble, gravel make up <90% of substrate	2
Average depth of channel at Ordinary High Water Mark (OHWM)	OHWM 20-39 cm	4
	OHWM 40-69 cm	3
	OHWM 70+ cm	2
	OHWM <20 cm	1
Average channel width	Average channel width >2 m	4
	Average channel width 1.25-2 m	2
	Average channel width <1.25 m	0
Percent cover of nonnative plants in alluvial bench	Nonnative cover ≤30%	4
	Nonnative cover >30-≤60%	2
	Nonnative cover >60%	0
Percent cover of nonnative plants in channel	Nonnative cover ≤1%	2
	Nonnative cover >1-≤10%	1
	Nonnative cover >10%	0
Percent cover of native plants in channel	Native plant cover ≤5	2
	Native plant cover >5-≤10%	1
	Native plant cover >10%	0

Habitat Scoring - Continued

Scoring Details

- Highest possible score was 54
- Scores ranged from 17 to 51
- Each score was given a percentage based on score out of total possible score (e.g. score of 27 would be 50%)

Habitat Quality Categories

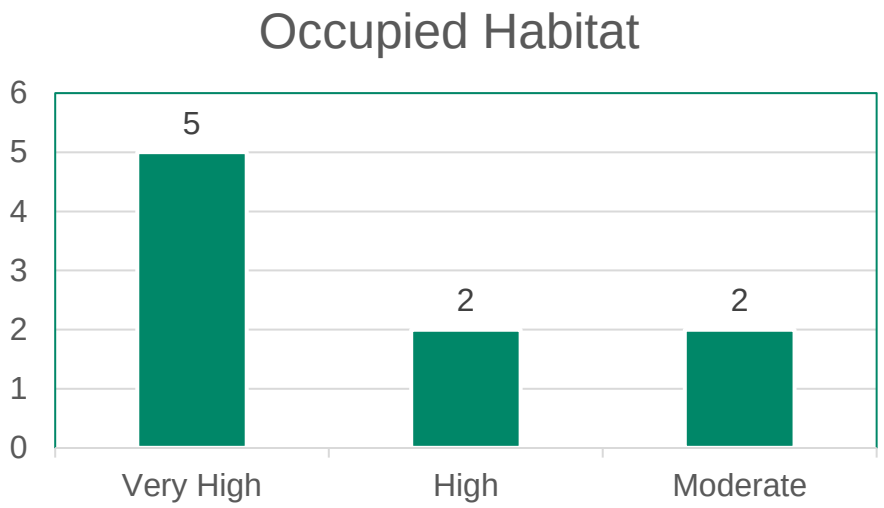
- Based on Habitat Scoring Matrix
- Habitat quality ranges were determined based on standard deviation from the mean score

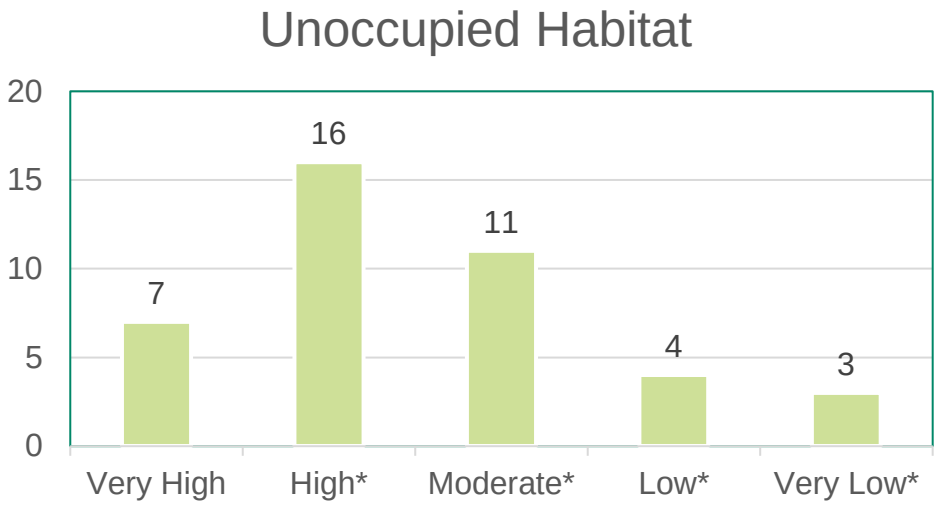
	Habitat Quality
Very High	>85-100
High	>67-85
Moderate	>51-67
Low	>34-51
Very Low	≤34

Habitat Scores for Suitable Canyons

Canyon ID[1]	Willowy Monardella Present	Stability	Alluvial Bench Width	Alluvial Bench Substrate	Alluvial Bench Presence	Native Cover Alluvial Benches	Channel Substrate	OHWM	Channel Width	Nonnative Cover Alluvial Benches	Nonnative Cover Channel	Native Cover Channel	Total Habitat Score	Percentage
34thStCynA	No	3	4	4	6	6	2	4	0	2	1	2	34	63.0
34thStCynL	No	8	4	1	0	6	4	4	4	4	1	0	36	66.7
BeelerCyn1A	No	3	8	4	6	6	4	4	2	2	1	2	42	77.8
BeelerCyn1C	No	0	0	6	0	6	3	1	0	2	0	0	18	33.3
BeelerCyn1I	No	0	8	4	6	6	4	1	2	2	2	2	37	68.5
BeelerCyn1U	No	0	8	4	6	6	3	4	0	2	2	2	37	68.5
ElanusCynA	No	3	4	6	0	6	3	3	3	6	2	2	38	70.4
FloridaCyn2A	No	8	4	4	6	0	3	3	4	4	2	0	38	70.4
LopezCynA	Yes	8	8	4	3	6	3	4	4	4	2	1	47	87.0
LopezCynM	Yes	5	8	1	3	3	4	2	4	4	1	2	37	68.5

Scoring Summary





***Unoccupied not "very high";**

- The extant willowy monardella was concentrated at or near the mouth where the drainage emptied into a larger occupied drainage.
- The surveyed habitat crossed from a secondary channel into a primary channel and occupied habitat occurred in the downstream reach of the survey area (i.e., primary channel).
- Why? water coming down the channel was supplemented by water flow in the drainage, whether due to above ground flow, due to water "backing up" in the mouth of the drainage as it joined the larger flow, or because the plants were likely able to access the main channel's water table.

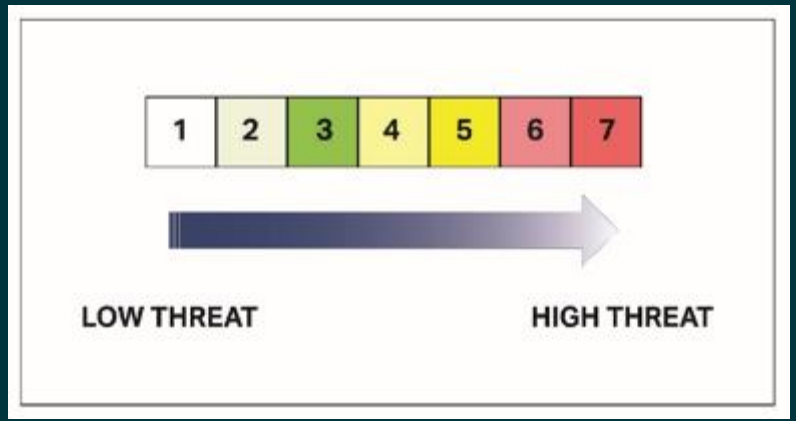
Threat Assessment

5 selected categories for analysis:

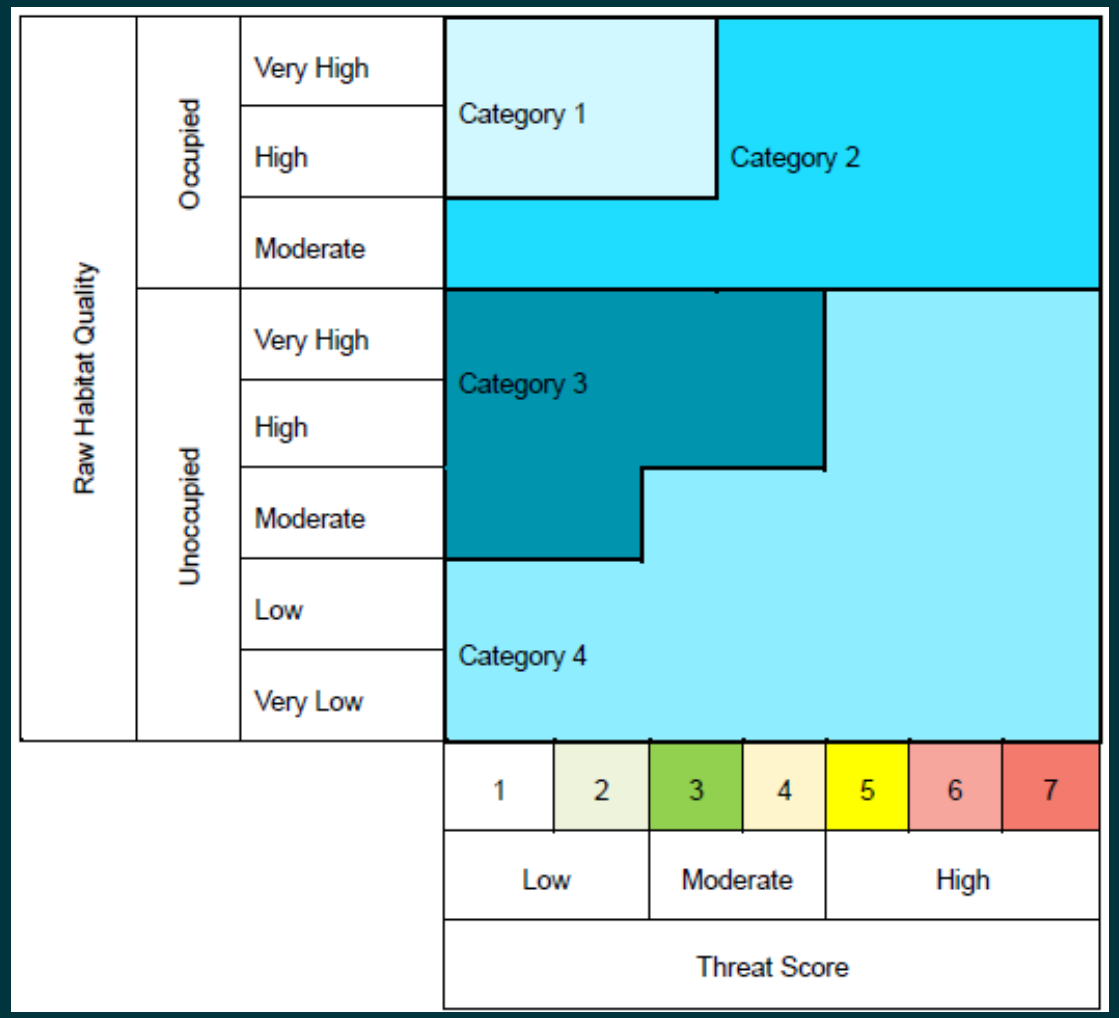
1. Fossorial Mammal Species Activity
2. Non-native Forbs
3. Non-native grasses
4. Altered Hydrology
5. Urban Runoff

Habitat Threat Scoring

Survey Area	Threats*						Average Threat Rating
	Fossorial Mammal Species Activity	Non-Native Forbs	Non-Native Grasses	Altered Hydrology	Urban Runoff	Average Threat Score	
34thStCynA	3	5	3	7	7	25	5.0
34thStCynL	3	3	3	7	7	23	4.6
BeelerCyn1A	5	6	7	1	1	20	4.0
BeelerCyn1C	4	6	7	1	1	19	3.8
BeelerCyn1I	7	3	6	1	5	22	4.4
BeelerCyn1U	7	7	7	7	7	35	7.0
ElanusCynA	5	7	7	7	7	32	6.4
FloridaCyn2A	4	3	4	1	3	15	3.0
LopezCynA	3	3	4	7	1	18	3.6
LopezCynM	2	3	3	7	3	18	3.6



Developing Management Priorities



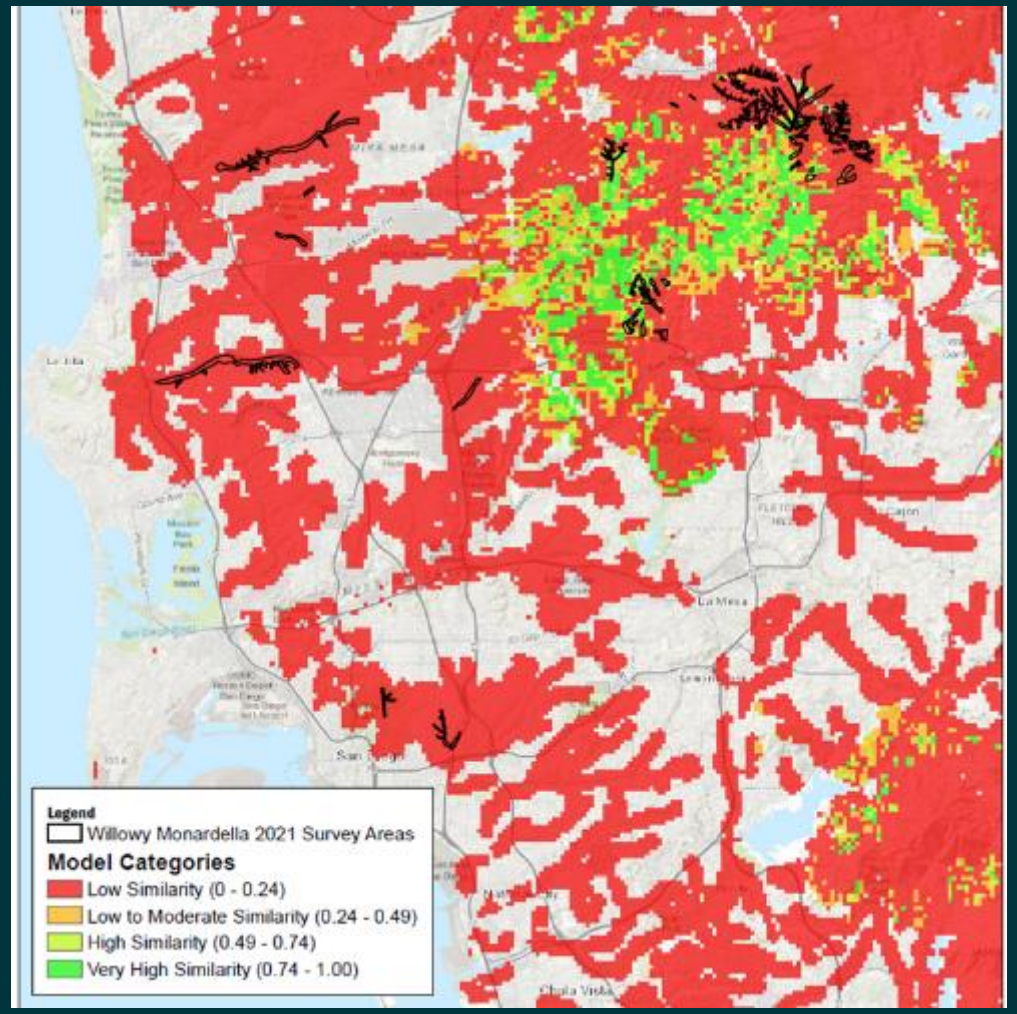
Management Category Plot

- Assigns each habitat area one of four categories
- Balances threats, habitat quality and occupancy
- General management approaches assigned to each category

Management Categories and Recommendation

Category	Recommendation	
1	Monitor	• Occupied high to very high habitat quality with low to moderate threat score These canyons are recommended for regular monitoring to identify any new threats to populations as they arise and to manage the overall population for stability in a proactive manner.
2	Mitigation/ Restoration	• Occupied moderate habitat quality with low threats, or • Occupied high or very high habitat quality with moderate to high threat score These canyons are recommended for prioritization of restoration and/or threat reduction management activities such as stabilization of channels, reduction in forbs or nonnative species, or control of fossorial mammals.
3	Reintroduction/ Establishment	• Unoccupied high to very high habitat quality with low to moderate threats, or • Unoccupied moderate habitat quality with low threats These canyons are recommended for prioritization of reintroduction or establishment, as they offer the highest quality observed habitats in combination with low threat scores. These canyons are all currently unoccupied by willowy monardella or have previously documented occurrences that have since been extirpated.
4	No Action	• Unoccupied low to very low habitat quality, or • Unoccupied moderate to high habitat quality with high threat score No action is recommended for these canyon systems due to the high number of resources likely needed to establish and maintain willowy monardella in conjunction with the low likelihood of success. These areas are not good candidates for inclusion in any species-specific management strategy.

Habitat Modeling Methods

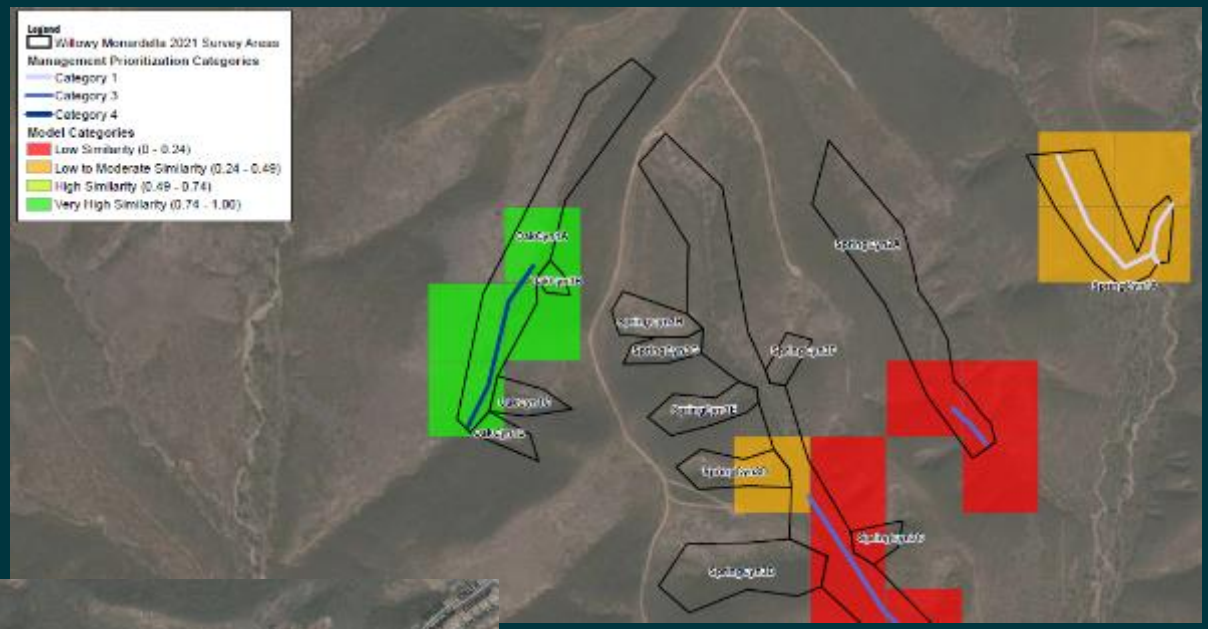


- Separate from field survey data and scoring
- Used remote sensed data
- Location data for 184 known occurrences were used
  - 110 randomly selected locations (60%) to construct models
  - 74 (30%) used to test performance
- 150-meter grid constructed across San Diego County
- Climactic, topographic, land use, vegetation variables calculated at each grid
- Alternative Mahalanobis D2 models used to calculate a multi variant mean for environmental characteristics of willowy monardella with different combinations of variables
  - Same set of characteristics evaluates at each 150-meter grid
  - The more similar characteristics within a grid the more suitable the habitat

Habitat Modeling Methods - Cont

Habitat suitability strata for the model are defined by Habitat Suitability Index (HSI) values as the following:

- Very High = 0.75–1.00;
- High = 0.50–0.74;
- Moderate = 0.25–0.49; and
- Low = 0–0.24.



Results – Habitat Modeling

- **Selected model performed well**
  - Predicting median HSI values of 0.82 for construction and 0.87 for evaluation data sets
  - Predicting mean HSI values of 0.64 for construction and 0.66 for evaluation data sets
  - Eight variables in top performing model
    - April to June min temperature
    - April to June max temperature
    - Average annual precipitation
    - Average annual stream flow
    - Average annual stream velocity
    - Cumulative catchment stream length upstream of grid
    - Percent impervious surface upstream of grid
    - Percent riparian land cover within 500 meters of grid

****Only small amount of suitable habitat outside current distribution**

Results Summary – Using Management Prioritization in Combination With Habitat Modeling

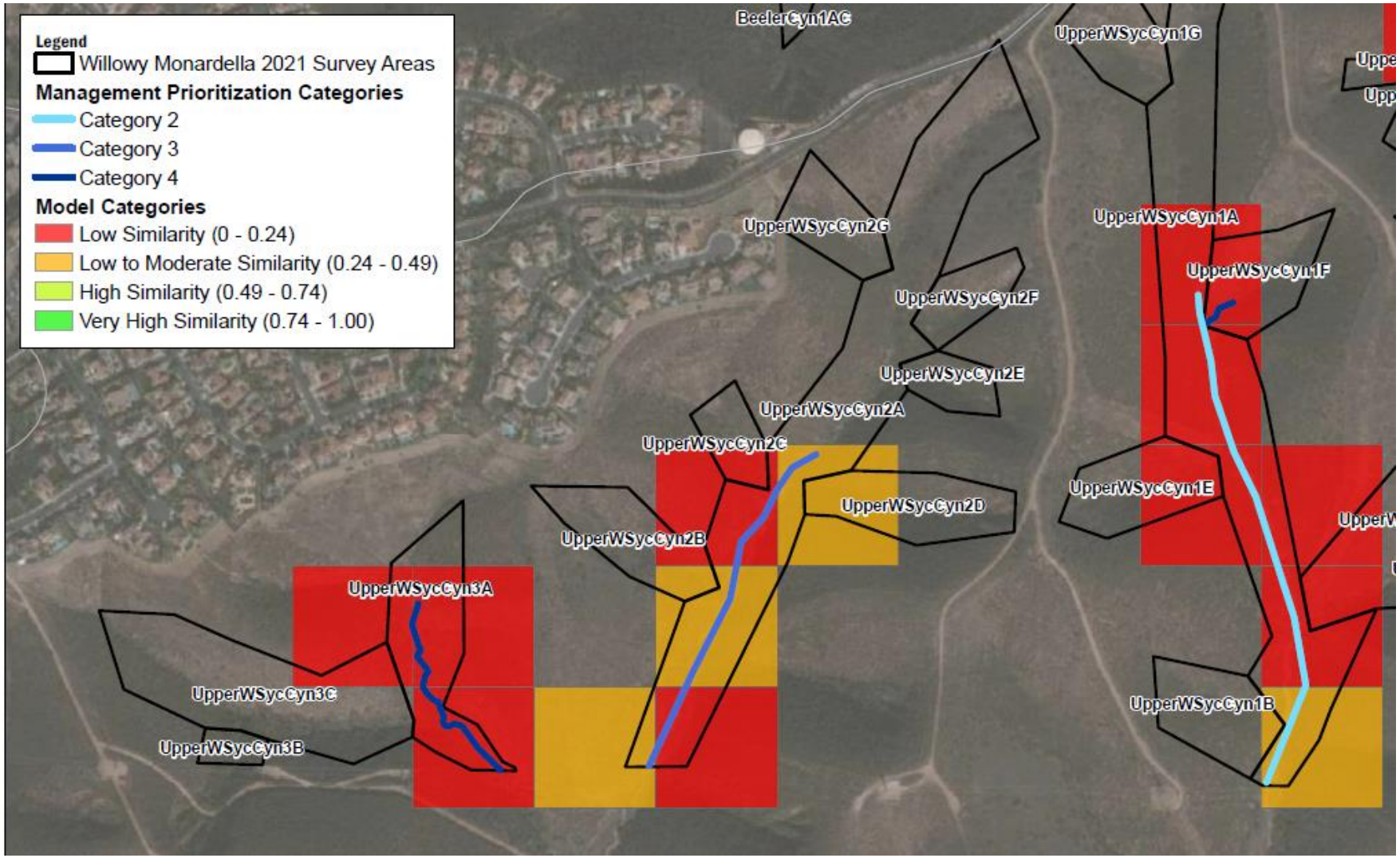
Management Prioritization of Conserved Lands

1. Habitat Suitability Score:
    1. Based on field data
    2. Scoring is relative to other occupied habitats on conserved lands
    3. Limited Study Area
2. Threat Score
    1. Provides average of 5 threat risks
    2. Identifies canyons which may not be suitable for establishment despite habitat characteristics
    3. Informs threats to existing populations or risks to establishment/restoration

Habitat Modeling

- Provides unbiased comparison to occurrences outside study area
- Utilizes remote sensed data not collected in field or seasonally available
- May be utilized to refine habitat suitability score at finer scale

Results Summary – Using Management Prioritization in Combination With Habitat Modeling



Questions?