SUB-HABITAT VULNERABILITY ASSESSMENT WORKSHEETS

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Prioritize the gray boxes in each section. If there is not enough time to complete the white boxes, the project team may populate these after the workshop and ask participants to review answers later.

Habitat: _____

1. Sensitivities to Climate and Climate-Driven Factors

Sensitivity involves factors that currently shape the habitat; exposure involves future climate changes that could affect the habitat, and is covered in another section below.

There are two ways to assess habitat sensitivity to climate and climate-driven factors:

(1) Whether the habitat exists in a relatively narrow climatic zone(s), and thus is more sensitive; or it exists in a relatively broad climatic zone(s) and thus is less sensitive;

(2) Whether the habitat experiences large changes in composition or structure due to small changes in climate or climate-driven factors, and thus is more sensitive; or the habitat experiences small changes even with larger changes in climate or climate-driven factors, and thus is less sensitive.

Instructions

Step 1: Using the list provided below, identify the factors that the habitat is sensitive to.

Step 2: For those factors that the habitat is sensitive to, estimate the degree of sensitivity, and your level of confidence in your estimate of sensitivity.

Step 3: If you have time, indicate any references that you feel are particularly relevant to your answers.

Air temperature	Timing of snowmelt & runoff	Water temperature
Precipitation (amount)	Soil moisture	Extreme events: heat waves
Precipitation (timing)	Altered stream flow regimes	Extreme events: drought
Snowpack amount	Extreme events: storms	Other (please specify)

FACTOR	DEGREE OF SENSITIVITY 1 (low) – 5 (high)	CONFIDENCE 1 (low) – 3 (high)	RELEVANT REFERENCES

FACTOR	DEGREE OF SENSITIVITY 1 (low) – 5 (high)	CONFIDENCE 1 (low) – 3 (high)	RELEVANT REFERENCES

Do any of the climate or climate-driven factors listed above BENEFIT the habitat? If so, list the factor and describe how the habitat benefits. *Include any relevant citations.*

Comments: *Provide any comments to support or clarify your conclusions above.*

2. Sensitivities to Disturbance Regimes

Natural disturbance regime is a concept that describes the pattern of disturbances that shape an ecosystem over a long time scale; it is distinguished from a single disturbance event because it describes a spatial disturbance pattern, a frequency and intensity of disturbances, and a resulting ecological pattern over space and time.

More sensitive habitats will show larger changes in composition or structure in response to relatively small climate-driven changes in disturbance regimes. Conversely, it would take much larger climate-driven changes in disturbance regimes to elicit a substantial change in composition or structure in less sensitive habitats. Changes in disturbance regimes may be either good or bad for the habitat.

Circle all disturbance regimes to which the habitat is sensitive (consider both magnitude and frequency):
If none apply, do not circle any.

Wildfire	Flooding	Insects	Other (please describe)
Disease	Wind	Grazing	

Overall, how sensitive is the habitat to the circled disturbance regimes? *1 – 5 (1=low sensitivity; 5=high sensitivity)*	**Confidence in the sensitivity to disturbance regimes:** *1 – 3 (1=low confidence; 3=high confidence)*
_____	_____

Comments and Citations: *Briefly describe your selection of disturbance regimes above, detailing how the specified disturbance regime affects the habitat.*

3. Future Climate Exposure

Climate exposure involves projected future climate changes that could affect the habitat and the likely degree of exposure to those changes.

Instructions

Step 1: Using the list provided below, identify the climate and climate-driven changes most relevant to consider for this habitat in the future.

Step 2: For those climate and climate-driven changes that the habitat is likely to be affected by, estimate the degree of exposure, and your level of confidence in your estimate of exposure. Use the information provided on projected future climate changes for the Central Valley to inform your estimate of degree of exposure.

Step 3: If you have time, indicate any potential areas of refugia from each climate or climate-driven change.

Increased air temperature	Earlier snowmelt & runoff	Increased wildfire
Changes in precipitation (amount)	Increased water temperatures	Extreme events: more heat waves
Changes in precipitation (timing)	Lower stream flows	Extreme events: more drought
Decreased snowpack	Increased flooding	Other (please specify)

CLIMATE OR CLIMATE-DRIVEN CHANGE	DEGREE OF EXPOSURE 1 (low) – 5 (high)	CONFIDENCE 1 (low) – 3 (high)	Potential Areas of Refugia from Change?

Overall confidence in your assessment of exposure: *1 – 3 (1=low confidence; 3=high confidence)* _____

4. Sensitivity and Current Exposure to Non-Climate Stressors

Sensitivity of the habitat to climate change impacts may be highly influenced by the existence, extent of, and current exposure to non-climate stressors. Although a habitat may be sensitive to a non-climate stressor, if it is not currently exposed to it/affected by it, the overall sensitivity of the habitat will be lower.

Instructions

Step 1: Using the list provided below, identify the non-climate stressors most likely to increase sensitivity of the habitat.

Step 2: For those non-climate stressors that your habitat is likely to be affected by, estimate the degree of current exposure, and your level of confidence in your estimate of current exposure.

Step 3: Indicate whether current exposure to a non-climate stressor occurs across the study area or is highly localized. If the current exposure occurs in a very particular location, indicate that specific location.

Urban/Suburban development	Groundwater overdraft	Roads, highways, trails	Pollution & poisons
Impervious surfaces	Invasive & other problematic species	Land use change	Nutrient loading
Dams, levees, & water diversions	Agriculture & rangeland practices	Other (please specify)	

NON-CLIMATE STRESSOR (add specific details about stressor – e.g., what kind of agricultural practices or land use change?)	**DEGREE STRESSOR AFFECTS SENSITIVITY 1 (low) – 5 (high)**	**CONFIDENCE 1 (low) – 3 (high)**	**IS EXPOSURE CONSISTENT ACROSS STUDY AREA OR HIGHLY LOCALIZED?** (if localized, identify locations)	**CONFIDENCE 1 (low) – 3 (high)**

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NON-CLIMATE STRESSOR (add specific details about stressor – e.g., what kind of agriculture or land use change?)	**DEGREE STRESSOR AFFECTS SENSITIVITY 1 (low) – 5 (high)**	**CONFIDENCE 1 (low) – 3 (high)**	**IS EXPOSURE CONSISTENT ACROSS STUDY AREA OR HIGHLY LOCALIZED?** (if localized, identify locations)	**CONFIDENCE 1 (low) – 3 (high)**

Comments and Citations: *Briefly describe how each of the stressors selected above are likely to make the habitat more sensitive to climate change.*

5. Other Sensitivities

Are there other critical factors that have not been addressed that influence the sensitivity of the habitat? *List below any other factor that you may consider critical to understanding the potential response of this habitat to climate change that was not represented with the previous questions. If no other factors apply, write N/A and specify your confidence associated with this question.*	**Collectively, to what degree do these factors influence habitat sensitivity?** *1 – 5 (1=low degree; 5=high degree)* _____

Confidence in the degree to which these factors influence habitat sensitivity: *1 – 3 (1=low confidence; 3=high confidence)*

_____

Comments and Citations: *Describe any "other sensitivities" and how they affect the habitat.*

Prioritize the gray boxes in each section. If there is not enough time to complete the white boxes, the project team may populate these after the workshop and ask participants to review answers later.

Habitat: _____

1. Extent, Integrity, and Continuity

Habitats that are currently widespread in their geographic extent, with high integrity and continuity likely have greater adaptive capacity, and may be more likely to withstand non-climate and climate stressors and persist into the future.

Habitats that are degraded, isolated, limited in extent, or currently declining due to non-climate and climate stressors likely have less adaptive capacity, and may be less likely to persist into the future.

What is the geographic extent of the habitat? *1 – 5 (1=endemic to my particular area; 5=transboundary)* _____	**Confidence in extent:** *1 – 3 (1=low confidence; 3=high confidence)* _____
What is the structural and functional integrity of the habitat? *1 – 5 (1=degraded; 5=pristine)* _____	**Confidence in integrity:** *1 – 3 (1=low confidence; 3=high confidence)* _____
How continuous is the habitat? *1 – 5 (1=isolated and/or quite fragmented; 5=continuous)* _____	**Confidence in continuity:** *1 – 3 (1=low confidence; 3=high confidence)* _____

Comments and Citations: *Provide any comments or citations to support or clarify your conclusions above.*

2. Resistance and Recovery

Some habitats may be more resistant to changes, stressors, or maladaptive human responses, or are able to recover more quickly from stressors; these habitats likely exhibit higher adaptive capacity.

Resistance: Resistance refers to the stasis of a habitat in the face of change. Some habitats may have higher tolerance thresholds than others in response to climate perturbations, leading to higher adaptive capacity. For example, habitats with species exhibiting drought adaptations (e.g., dormancy) may be better able to survive and/or withstand significant changes in the face of altered water availability. Alternatively, maladaptive human interventions can reduce the resistance of a habitat by accelerating rates or severity of change, leading to lower adaptive capacity. For example, vegetation management activities intended to reduce fire risk could impact aquatic systems if they lead to increased sedimentation and erosion, decreasing overall adaptive capacity.

Recovery: Some habitats may have more rapid regeneration times and/or are dominated by species with short generation times. Habitats with a shorter recovery period from the impacts of stressors (<20 years) may have greater intrinsic adaptive capacities than slower developing/recovering habitats (>20 years), as slower recovering habitats may be more intrinsically vulnerable to the potential intervening effects of climate change.

To what degree is the habitat resistant to the impacts of stressors/maladaptive human responses? *1 – 5 (1=low degree; 5=high degree)* _____	**Confidence in resistance:** *1 – 3 (1=low confidence; 3=high confidence)* _____
To what degree is the habitat able to recover from the impacts of stressors? *1 – 5 (1=low degree; 5=high degree)* _____	**Confidence in recovery:** *1 – 3 (1=low confidence; 3=high confidence)* _____

Comments and Citations: *Provide any comments or citations to support or clarify your conclusions above.*

3. Landscape Permeability

More permeable landscapes with fewer barriers to dispersal and/or migration will likely result in greater adaptive capacity for habitats.

Instructions

Step 1: Using the list provided below, identify the most relevant barriers to continuity/dispersal for this habitat.

Step 2: For each barrier to continuity/dispersal, specify the type of barrier, estimate the degree of to which the barrier affects habitat continuity, and estimate your level of confidence in your assessment of the impact of the barrier on habitat continuity.

Step 3: If you have time, indicate any references that you feel are particularly relevant to your answers.

Urban/Suburban development	Agricultural & rangeland practices	Land use change
Energy production & mining	Invasive & other problematic species	Riprap
Roads, highways, trails	Dams, water diversions, & levees	Geologic features
Other (please specify)		

BARRIER TO CONTINUITY (specify type of barrier: e.g., Land use change - conversion to vineyard)	**DEGREE BARRIER AFFECTS HABITAT CONTINUITY 1 (low) – 5 (high)**	**CONFIDENCE 1 (low) – 3 (high)**	**RELEVANT REFERENCES AND COMMENTS**

Comments and Citations: *Provide any comments or citations to support or clarify your conclusions above.*

4. Habitat Diversity

Habitats that include diverse physical and topographical characteristics (e.g., variety in aspects, sediment types, elevation) may have higher adaptive capacity.

The level of diversity of component species and functional groups in a habitat may affect the adaptive capacity (or sensitivity) of that habitat to climate change impacts. For example, habitats with multiple species per functional group likely have greater adaptive capacity because response to changes in climate varies among the species. More habitat diversity in terms of component species and functional groups may increase adaptive capacity.

What is the level of diversity of the physical and topographical characteristics of the habitat? *1 – 5 (1=low; 5=high)* _____	**Confidence in physical/ topographical diversity:** *1 – 3 (1=low confidence; 3=high confidence)* _____
What is the level of diversity of component species in the habitat? *1 – 5 (1=low; 5=high)* _____	**Confidence in component species diversity:** *1 – 3 (1=low confidence; 3=high confidence)* _____
What is the level of diversity of functional groups in the habitat? *1 – 5 (1=low; 5=high)* _____	**Confidence in functional group diversity:** *1 – 3 (1=low confidence; 3=high confidence)* _____

Are any of the component species or functional groups in this habitat particularly sensitive to climate change? *If yes, identify and describe how they are sensitive and whether or not they currently have any special listings in the study area (e.g., threatened, endangered).*

Is the habitat dependent upon a single keystone or foundational species? If yes, describe.

Are there other diversity factors that are important to consider for the habitat that are not listed above? If so, describe.

Comments and Citations: *Provide any comments or citations to support or clarify your conclusions above.*

5. Management Potential

Management potential reflects our ability to impact the adaptive capacity and resilience of a habitat to climatic changes.

Management potential can be evaluated in two ways:
(1) Societal value: Is the habitat highly valued? Habitats with a high societal value likely have higher adaptive capacity, as people may have a greater interest in protecting and/or maintaining them and the ecosystem services they provide.
(2) Managing or alleviating climate impacts: Can climate impacts on the habitat be managed or alleviated? If human intervention or management has a high likelihood of alleviating climate impacts, the adaptive capacity of a habitat is likely higher. The costs and benefits of management actions will vary depending on the habitat type; actions will be most feasible when the habitat and/or its services are culturally and economically valued and the costs of implementing actions are low.

How much do people value this habitat (e.g., because of services it provides such as recreation opportunities, aesthetic value, etc.)? *1 – 5 (1=low value; 5=high value)* _____	**Confidence in habitat value:** *1 – 3 (1=low confidence; 3=high confidence)* _____
Describe habitat value.	
How much societal support (e.g., financial, regulatory, legislative) is there for managing or conserving this habitat? *1 – 5 (1=low support; 5=high support)* _____	**Confidence in societal support:** *1 – 3 (1=low confidence; 3=high confidence)* _____
Describe societal support.	
To what degree can agriculture and/or rangelands benefit/support/increase resilience of this habitat? *1 – 5 (1=low degree; 5=high degree)* _____	**Confidence in degree:** *1 – 3 (1=low confidence; 3=high confidence)* _____
Describe how agriculture and rangelands benefit/support/increase resilience of this habitat.	

To what degree would extreme events (e.g., flooding, extended drought) influence societal support for taking action? *1 – 5 (1=low degree; 5=high degree)* _____	**Confidence in degree:** *1 – 3 (1=low confidence; 3=high confidence)* _____
Describe the type of event that may influence societal support.	
What is the likelihood of or support for retired agriculture land being converted to this habitat? *1 – 5 (1=low likelihood; 5=high likelihood)* _____	**Confidence in likelihood:** *1 – 3 (1=low confidence; 3=high confidence)* _____
Describe likelihood of or support for retired agriculture land being converted to this habitat.	
What is the likelihood of managing or alleviating climate impacts for this habitat? *1 – 5 (1=low likelihood; 5=high likelihood)* _____	**Confidence in likelihood:** *1 – 3 (1=low confidence; 3=high confidence)* _____
Describe likelihood of managing or alleviating climate impacts.	

6. Other Adaptive Capacity Factors

Are there other critical factors that have not been addressed that may affect the habitat's adaptive capacity? *List below any other factor that you may consider critical to understand the potential adaptive response of the habitat to climate change that has not been addressed yet. If no other factors apply, write N/A and specify your confidence associated with this question.*	**Collectively, to what degree do these factors affect the adaptive capacity of the habitat?** *1 – 5 (1=low degree; 5=high degree)* _____
Confidence in the degree to which these factors affect the habitat's adaptive capacity: *1 – 3 (1=low confidence; 3=high confidence)* _____	
Comments and Citations: *Describe any other adaptive capacity factors for the habitat.*	