Persist in Place or Shift in Space?

Applying Assessments of Species' Adaptive Capacity to Inform Climate Adaptation Actions

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How do you define adaptive capacity in the context of climate change or other environmental change(s)?

Have you included an assessment of adaptive capacity (whether quantitative or qualitative) in any of your work?

B. Wick

Overview

01 Adaptive Capacity 101
Advancements in our understanding of species' adaptive capacity

02 Assessment Framework
Using the AC "wheel"

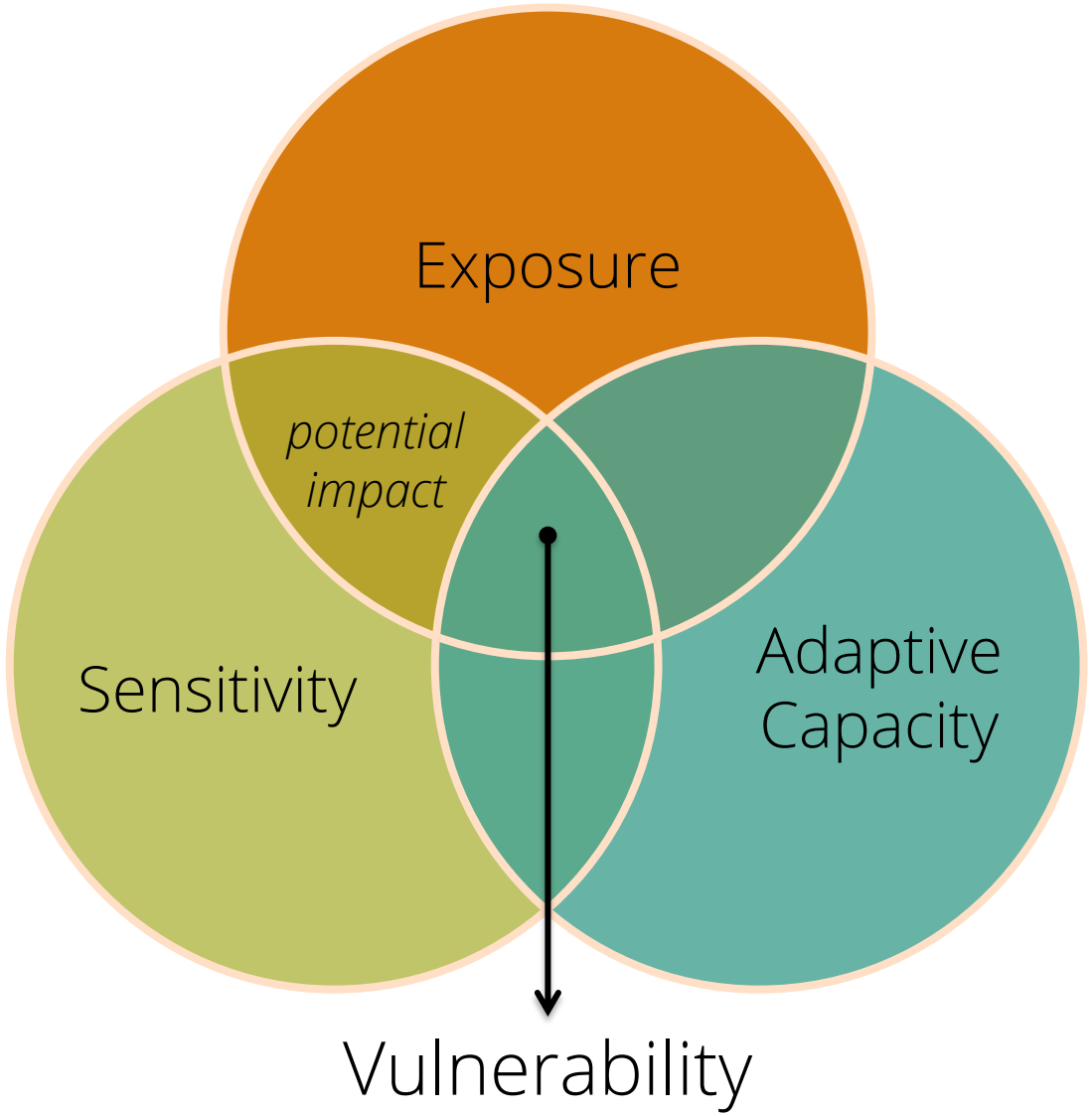
03 Bridging Research & Practice
AC-informed adaptation menu

Climate change vulnerability

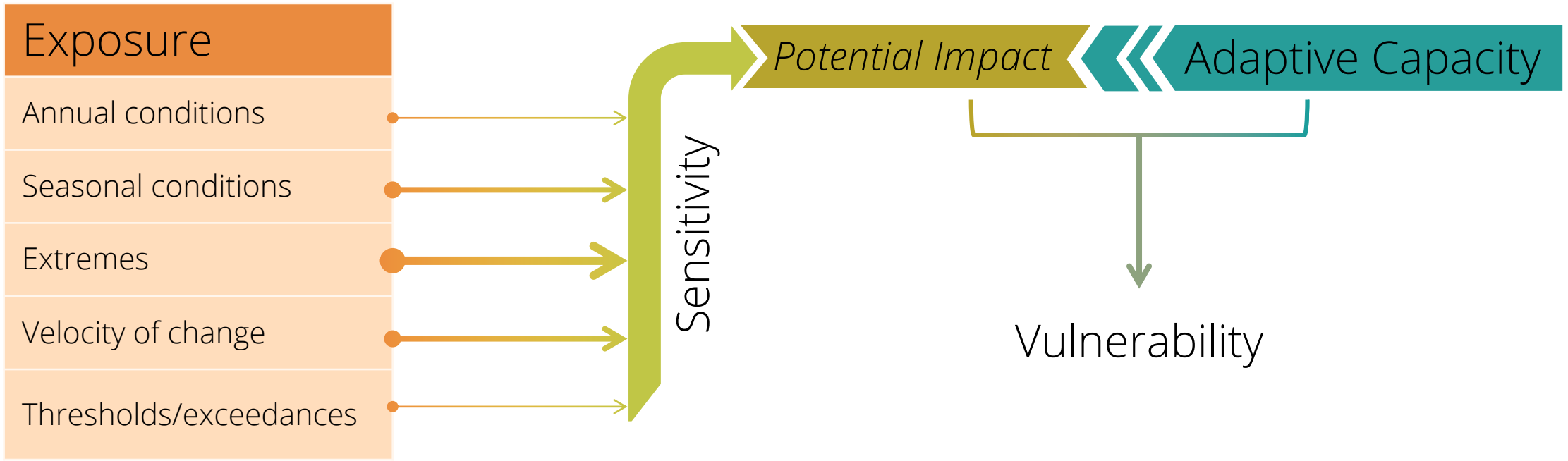
Rate and magnitude of climate change experienced

Dose-response (susceptibility or degree of impact)

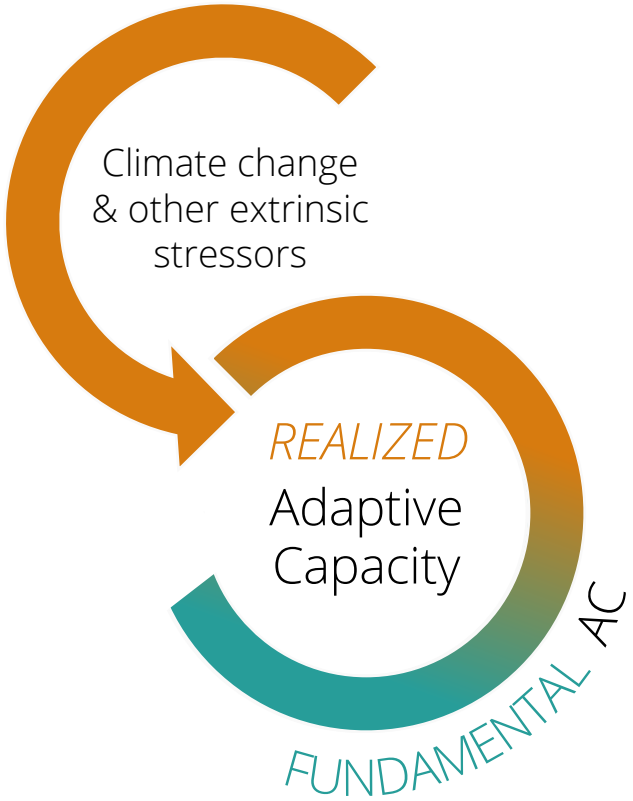
Ability to cope with or adjust to changes



Climate change vulnerability



Persist in place or shift in space? Evaluating the adaptive capacity of species to climate change.
Thurman et al (2020) *FrEE*
https://doi.org/10.1002/fee.2253



Improving conservation outcomes with a new paradigm for understanding species adaptive capacity.
Beever et al (2016) *Conserv Lett*
https://doi.org/10.1111/conl.12190

I. Meshcheryakovova

S. McMillan

ICanHasCheezburger.com

Persist in place
(adapt *in situ* /acclimate)

Shift in space
(move to track suitable climate)

Perish
(local/rangewide extinction)

Thurman et al (2020) https://doi.org/10.1002/fee.2253

"It's me, hi! I'm the problem, it's me."
- Taylor Swift

Species' attributes that may confer *greater* adaptive capacity

- Shorter generation time
- Higher fecundity
- Greater genetic diversity
- Ecological "generalists"
- Greater dispersal capacity
- Broad spatial distribution
- Populations where climatic changes are of intermediate magnitude

N. Hawkins

Nicotra et al (2015) https://doi.org/10.1111/cobi.

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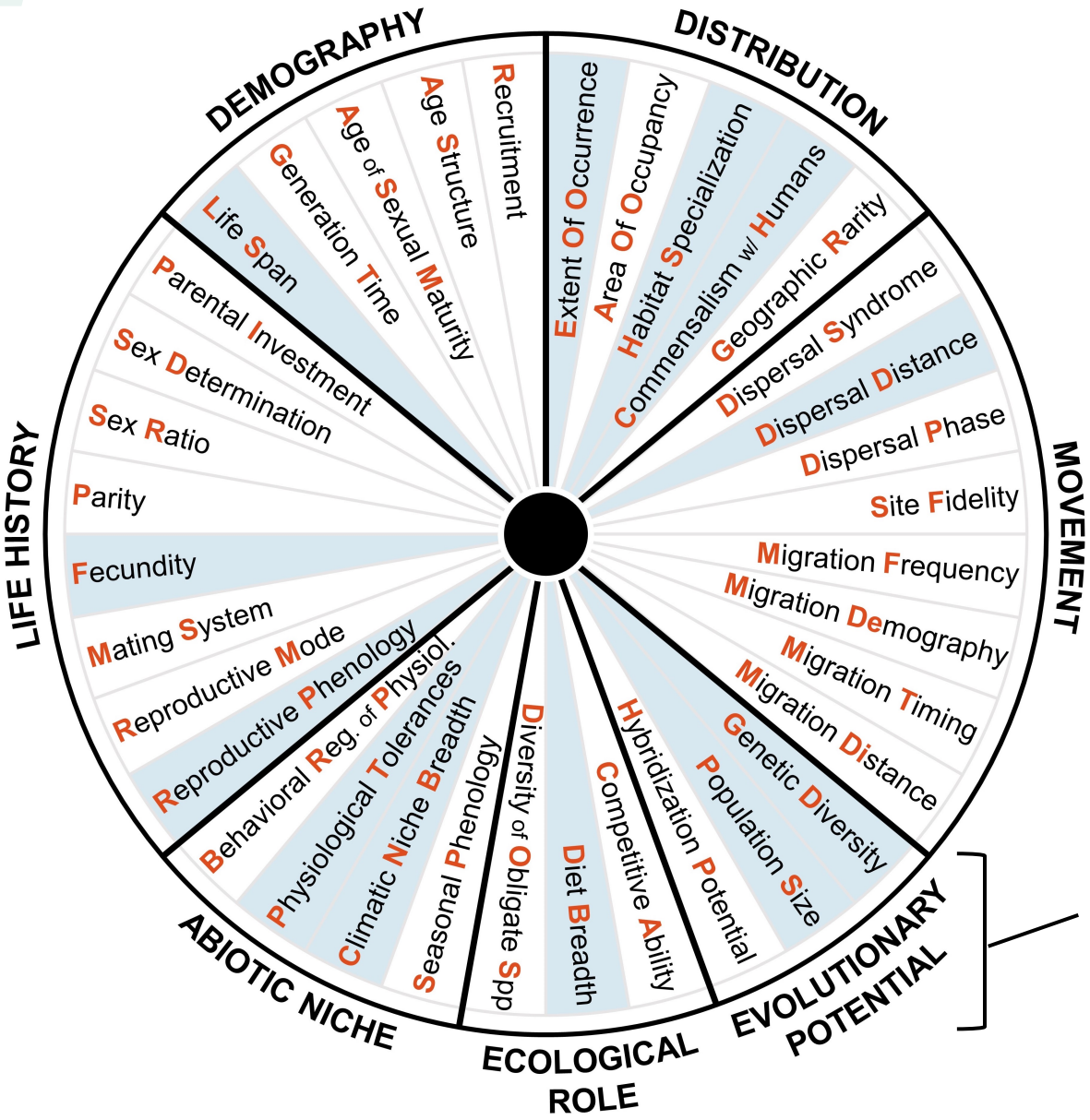

- 36 attributes
- 7 complexes (groups)
- 12 core attributes

Connecting research and practice to enhance the evolutionary potential of species under climate change. Thompson et al (2023) *Conserv Sci Prac* https://doi.org/10.1111/csp2.12855

Thurman et al (2020) https://doi.org/10.1002/fee.2253

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Attribute | Persist in Place (PiP) or Shift in Space (SiS) | Relevance to AC | Scale of assessment | eg, mobile vs sessile | AC criteria

Attributes	PiP and/or SiS	Definition	Relevant taxonomic scale	Additional specifications	Level of AC			
					Low	Moderately low / Moderate	Moderately high / Moderate	High
Extent of occurrence (EOO)	PiP and SiS	The area contained within the shortest continuous boundary that can be drawn to encompass all known, inferred, or projected sites of present occurrence of a taxon, excluding cases of vagrancy (IUCN 2012); in the case of migratory species, EOO should be based on the minimum of breeding or non-breeding areas, but not both because the bulk of the population is found in only one of these areas at any given time	Species level		< 100 km^2	100–5000 km^2	5000–20,000 km^2	> 20,000 km^2

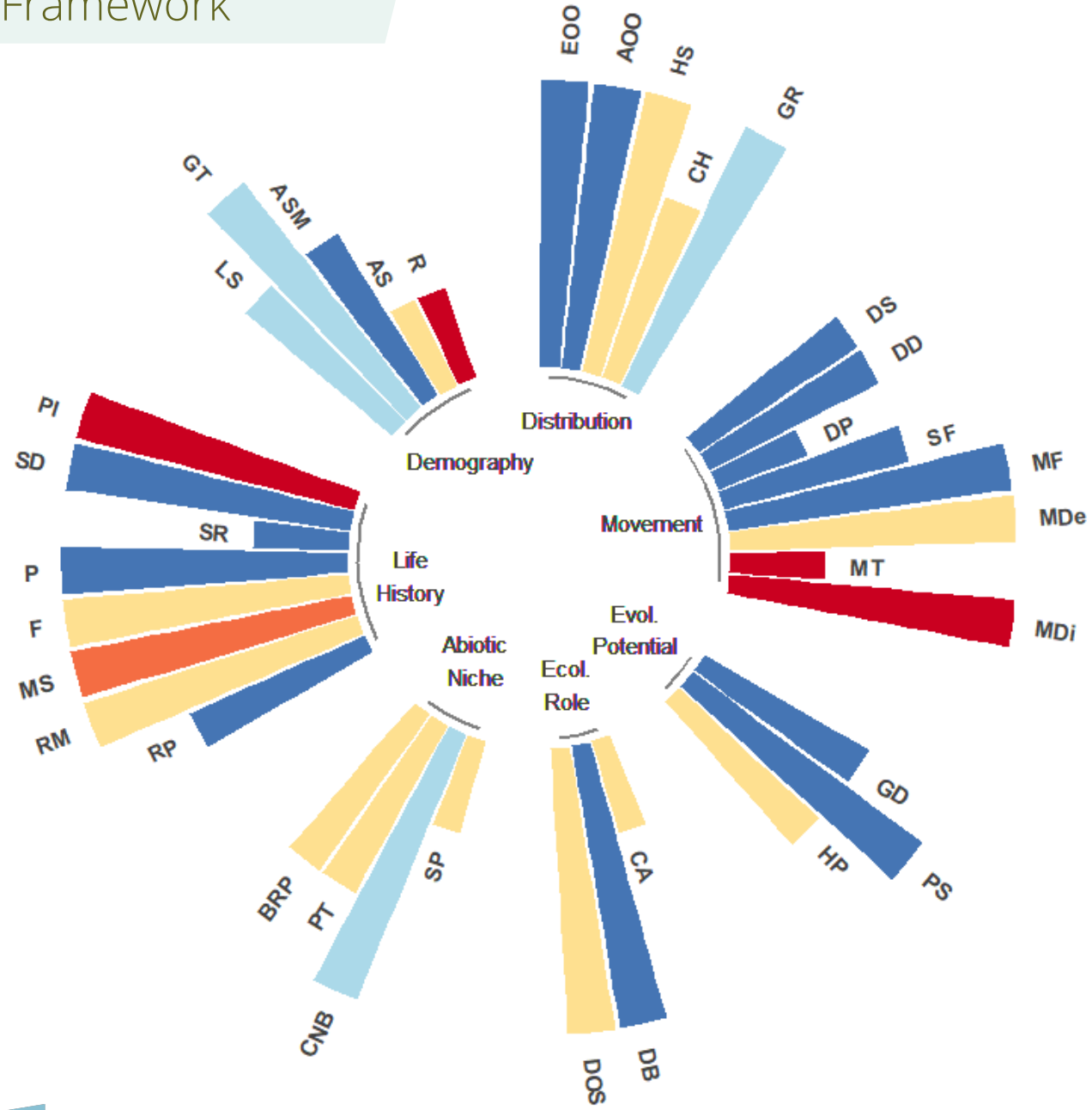
Thurman et al (2020) https://doi.org/10.1002/fee.2253

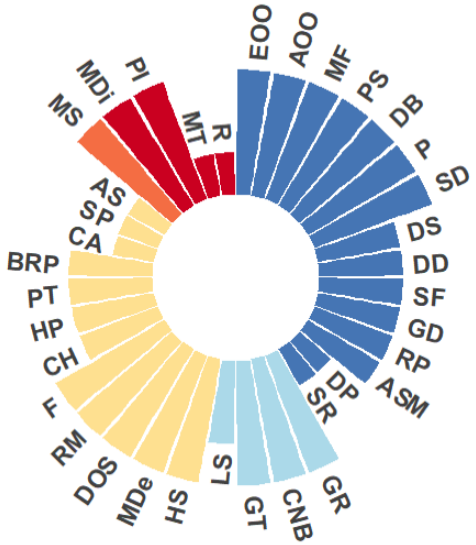
Attributes	Adaptive Capacity	Additional Information/Justification	Evidence
Geographic Rarity (GR)	MODERATELY HIGH: Broadly distributed with sparse or isolated populations	Ruth (2015): "Grasshopper Sparrow is still a relatively common and broadly distributed species, but because of significant population declines and stakeholder concerns, the species is considered of conservation concern nationally and at the state level for numerous states." Vickery (2020): "Although the Grasshopper Sparrow appears to have a wide distribution across much of temperate North America, it is often locally distributed and even uncommon to rare throughout parts of its range. Many North American populations have experienced long-term declines since the early part of this century, owing mostly to loss and conversion of prairies and agricultural grasslands." Designated a Common Bird in Steep Decline by Partners in Flight (https://partnersinflight.org/species/grasshopper-sparrow/)	HIGH: accepted consensus from peer-reviewed literature (at least two publications in agreement), or general knowledge (e.g., taxonomically determined)

J. McCumber

Grasshopper sparrow

J. McCumber



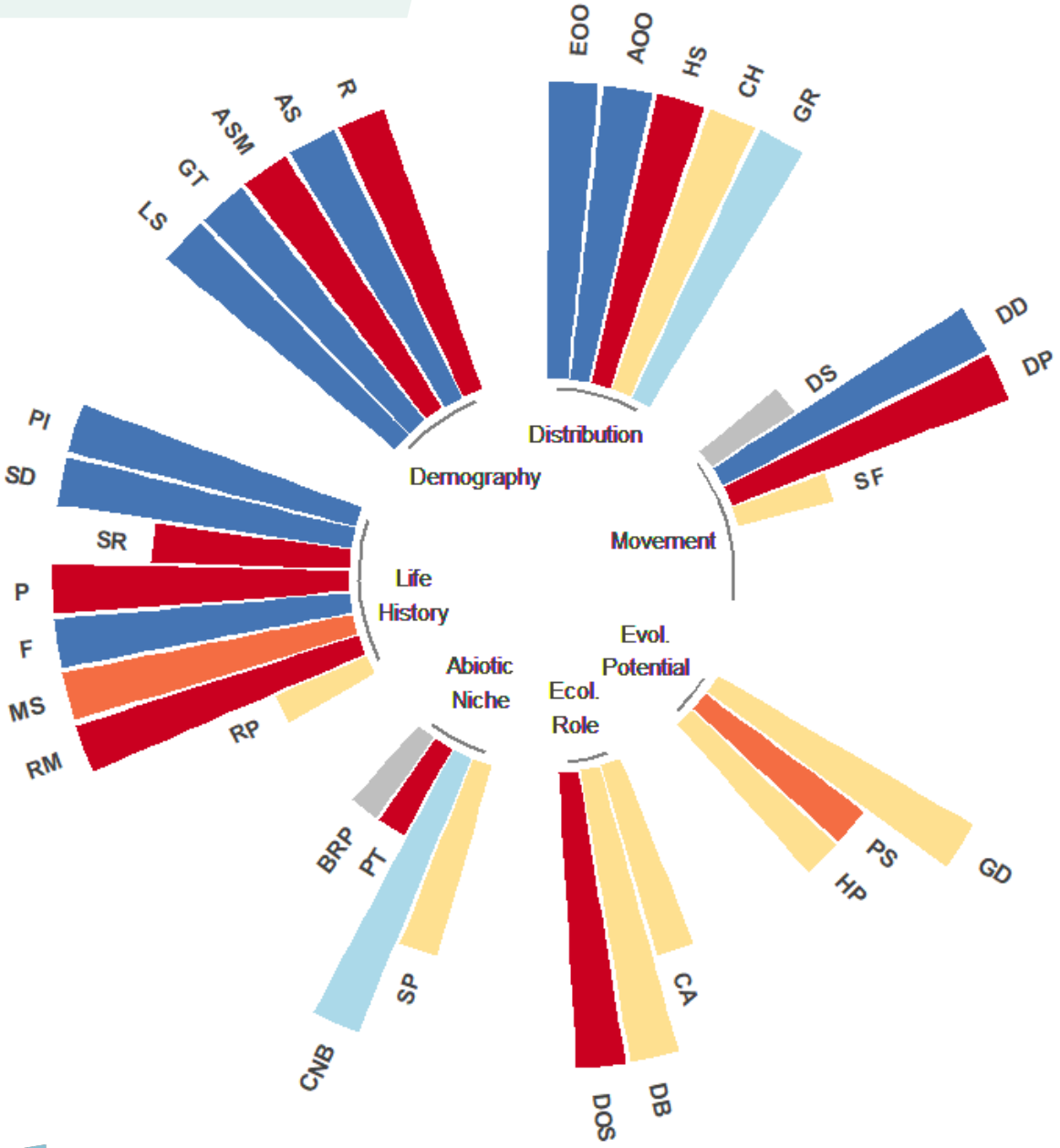


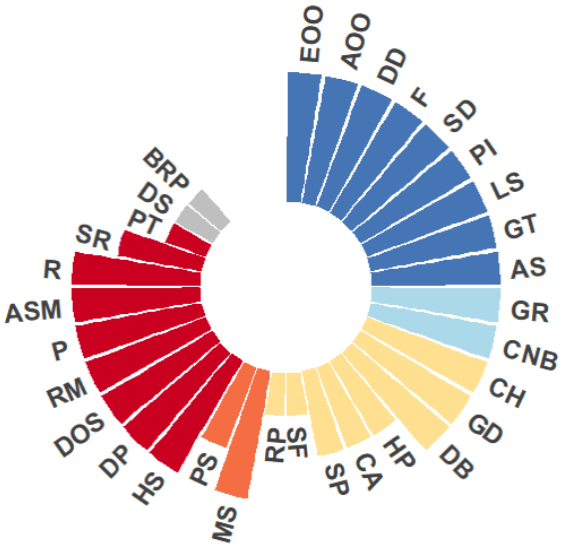
AC
- high
- moderately high
- moderate
- moderately low
- low

Evidence: Low Mod High

Regal fritillary

Wisconsin DNR





AC

- high
- moderately high
- moderate
- moderately low
- low
- unknown

Evidence: Low Mod High

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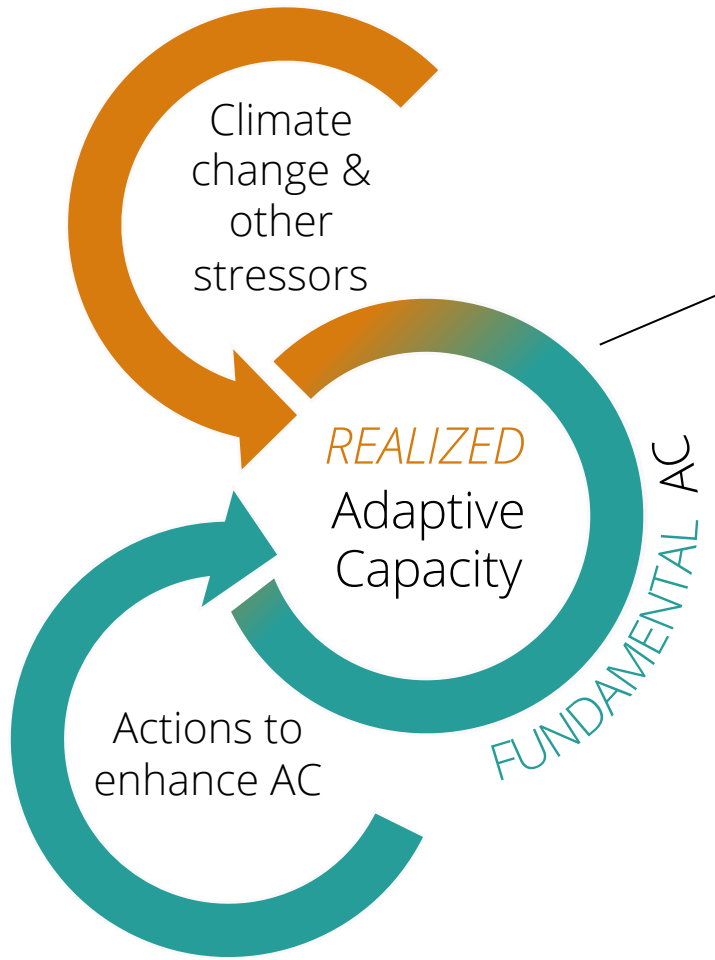
Supporting the adaptive capacity of species through more effective knowledge exchange with conservation practitioners.
Cook et al (2021) *Evol Appl*
http://dx.doi.org/10.1111/eva.13266

Applying assessments of adaptive capacity to inform conservation planning in a changing climate.
Thurman et al (2021) *Conserv Biol*
https://doi.org/10.1111/cobi.13838



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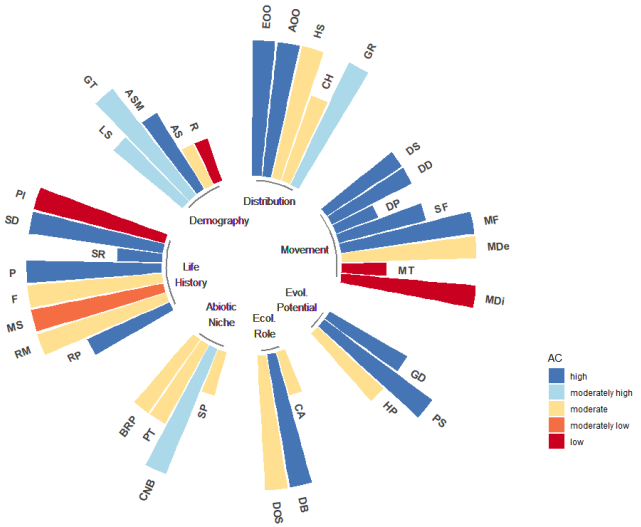
1. Inform the process (set goals)

2. Assess climate vulnerabilities (incl. adaptive capacity)



3. Evaluate implications for management goals

4. Identify and select from AC-informed adaptation menu

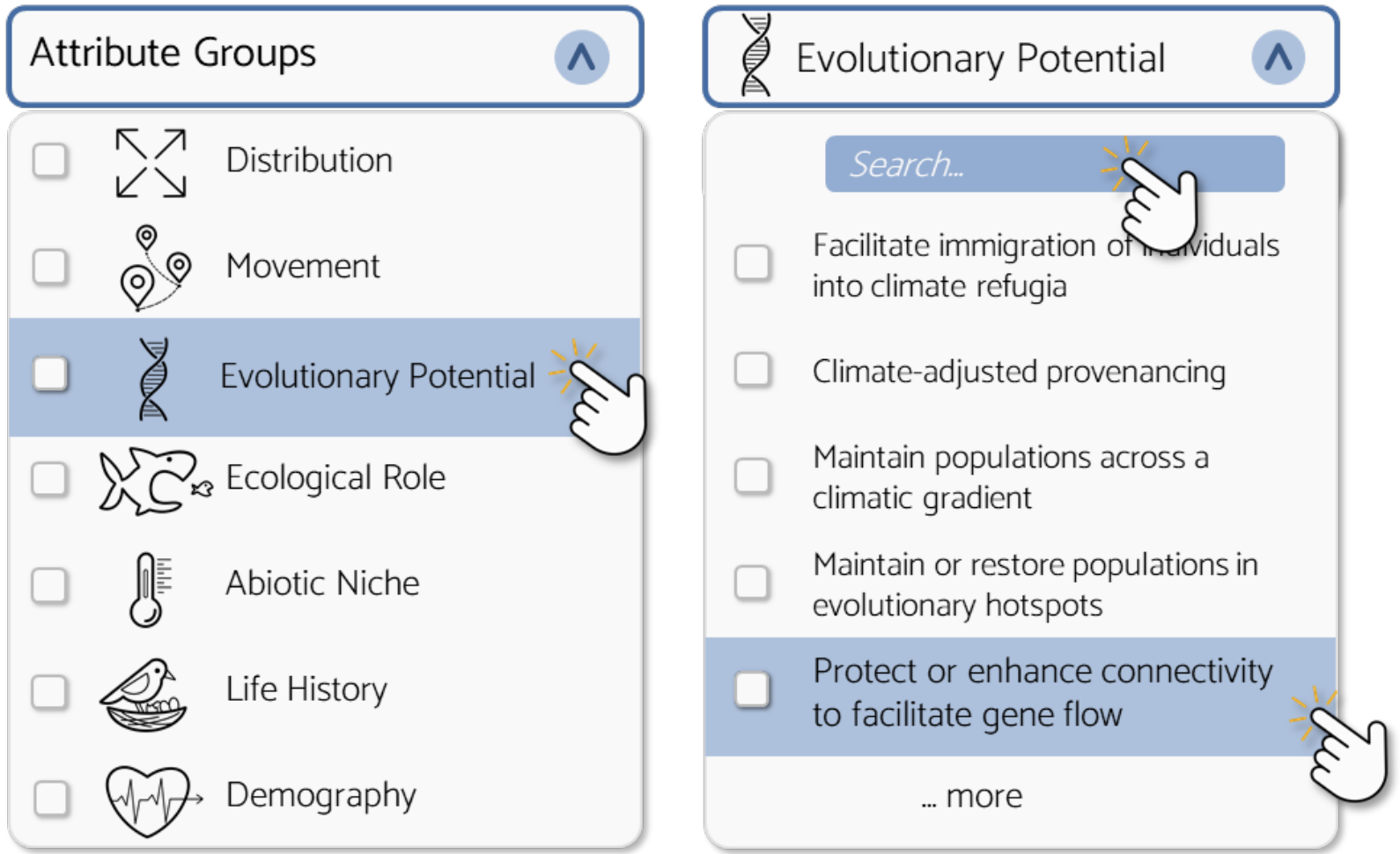
5. Implement action(s) and track response/ effectiveness

TABLE 1 Examples of general adaptation actions for each of three potential management approaches related to reducing climate change vulnerability

Component of vulnerability	Examples of adaptive-capacity-informed adaptation actions
Directly enhance fundamental adaptive capacity	maintain or maximize genetic diversitymaintain or maximize population sizeintroduce threat-resistant genotypes through non-local or climate-adjusted provenancingsupport flexibility in behaviorsupport flexibility in resource use
Indirectly enhance adaptive capacity (i.e., enhance realized adaptive capacity) by minimizing ecological or anthropogenic constraints or stressors	assisted colonization or translocation to the leading edge of rangeprotect macro- and microclimatic refugia to support phenotypic plasticity and local adaptationprotect or enhance connectivitycontrol biotic stressors (e.g., disease and non-native competitors)ensure availability of key resources
Manage exposure or sensitivity where adaptive capacity cannot feasibly be enhanced	protect macro- and microclimatic refugia to reduce exposureartificially select for threat-resistant genotypes in sensitive speciestranslocation to reduce exposure

Thurman et al (2022) https://doi.org/10.1111/cobi.13838

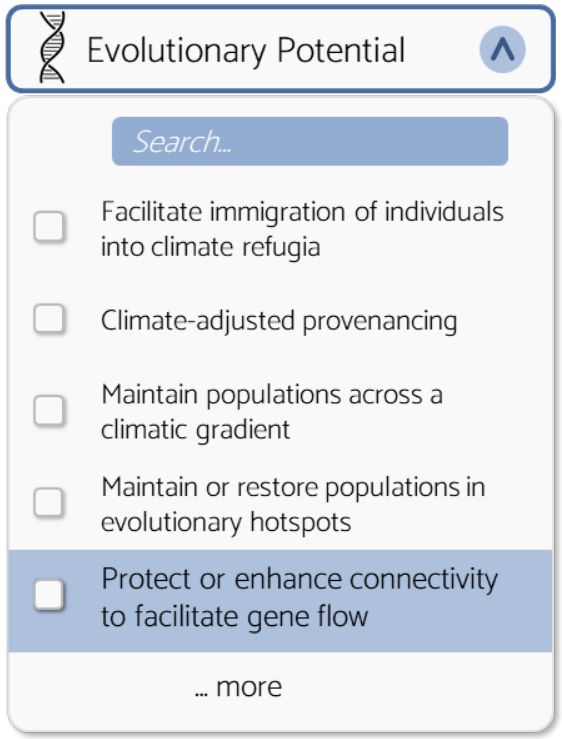
Adaptation Menu



"Genetic diversity"

Thurman et al (2022) https://doi.org/10.1111/cobi.13838

Adaptation Menu



Action

Protect or enhance connectivity to facilitate gene flow among populations at sites with suitable future climates through maintenance of critical connectivity pinch points, removal of movement barriers (e.g., dam removal or decommissioning roads), or installation of passages (e.g., fish ladders, road culverts, wildlife overpasses, etc.).

Goals

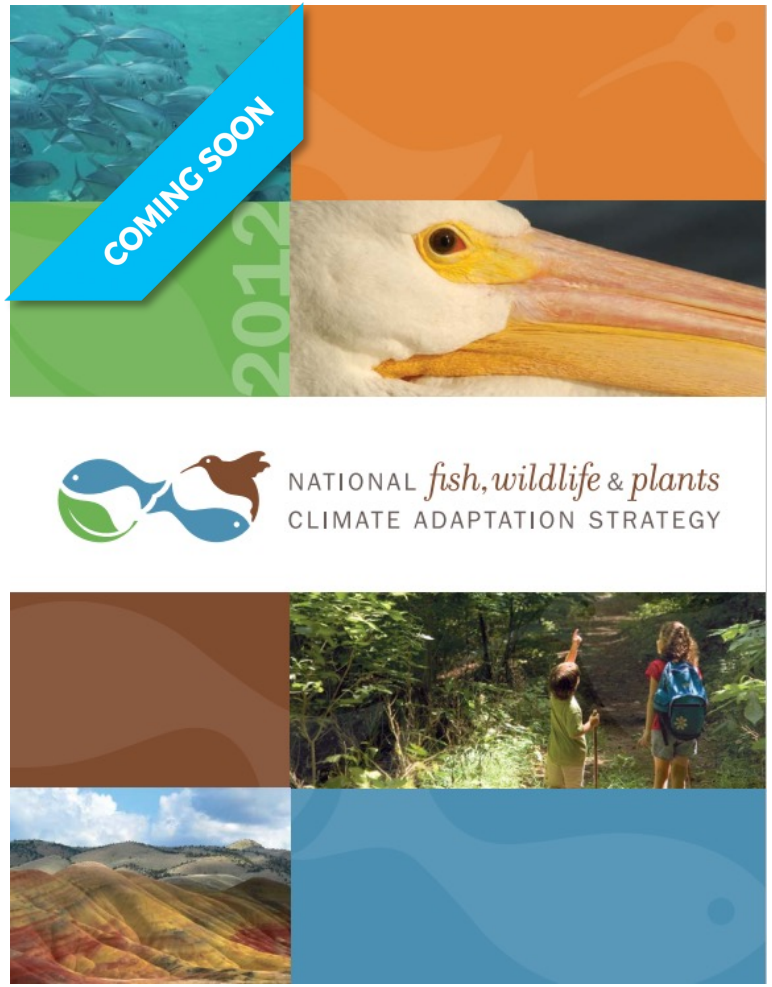
- Allow for optimal gene flow among populations
- Increase genetic diversity, especially across broader spatial extents and at the 'leading edge' of the species' range.
- Increase effective dispersal.
- Reduce potential for genetic drift.
- Avoid swamping local adaptation (homogenization) and minimize risk of disease transmission.
- Minimize loss of isolated populations to stochastic events.

Examples

- Low-quality habitat corridors as movement conduits for two butterfly species (Haddad & Tewksbury 2005)
- Long-term viability of Department of the Interior bison under current management and potential metapopulation management strategies (Hartway et al 2020)
- Pacific lamprey recolonization of a Pacific Northwest river following dam removal (Jolley et al 2018)

Thurman et al (2022) https://doi.org/10.1111/cobi.13838

03 Bridging Research & Practice



Linking Adaptive Capacity to Species Status Assessments

Version 1.0, September 2021

This resource was prepared by U.S. Fish and Wildlife Service (Service) and U.S. Geological Survey staff as an internal job aid for Service species status assessment (SSA) practitioners. It provides answers to frequently asked questions and best practices for applying the concept of adaptive capacity into SSAs. This resource may be updated over time as new information becomes available and we learn from our experiences.

An SSA is a biological risk assessment that describes a species' viability, that is, its ability to maintain populations in the wild over time. To assess viability of species in SSAs, we use the conservation-biology principles of the 3Rs - resiliency, redundancy, and representation (Shaffer and Stein 2000, pp. 308-311). *Resiliency* is the ability of a species to withstand environmental stochasticity, periodic disturbances within the normal range of variation, and demographic stochasticity. *Redundancy* is the ability of a species to withstand catastrophes. *Representation* is the ability of a species to adapt to both near-term and long-term changes in its physical and biological environments (see The 3Rs Defined document for full working definitions). The purpose of this document is to describe the relationship between adaptive capacity and representation and provide a framework for assessing representation in SSAs.

Table of Contents

1

AC Quick Reference Guide & Resources

https://tinyurl.com/AC-how-to

Has your understanding of adaptive capacity changed? If so, ...

How might you include assessments of adaptive capacity (whether quantitative or qualitative) in your ongoing or future work?