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# Marine mammal climate vulnerability assessments

Marine Mammal Commission  
Annual Meeting  
November 15, 2023

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ECS Federal in support of NOAA Fisheries  
Office of Science and Technology



*Laura Morse, NOAA Fisheries*



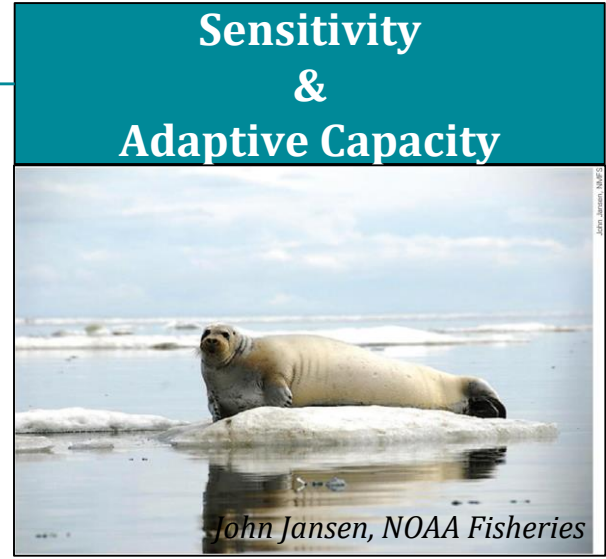
*NOAA Fisheries HI Monk Seal Research Program*



*Mark Sullivan, NOAA Fisheries*



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**Vulnerability**

Morrison et al. 2015, *NMFS-OSF-3*  
Hare et al. 2016, *PLOS ONE*



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# Sensitivity and Adaptive Capacity

<b>Prey</b>	<ul style="list-style-type: none"><li>• <b>Prey/Diet Specificity</b></li></ul>
<b>Habitat</b>	<ul style="list-style-type: none"><li>• <b>Habitat Specificity</b></li><li>• <b>Site Fidelity</b></li></ul>
<b>Reproduction</b>	<ul style="list-style-type: none"><li>• <b>Lifetime Reproductive Potential</b></li><li>• <b>Generation Time</b></li><li>• <b>Reproductive Plasticity</b></li></ul>
<b>Spatial</b>	<ul style="list-style-type: none"><li>• <b>Migration</b></li><li>• <b>Home Range</b></li></ul>
<b>Population</b>	<ul style="list-style-type: none"><li>• <b>Stock Abundance</b></li><li>• <b>Stock Abundance Trend</b></li></ul>
<b>Threats</b>	<ul style="list-style-type: none"><li>• <b>Cumulative Stressors</b></li></ul>



# Exposure Factors

Magnitude of change a population is expected to experience

- Sea Surface Temperature
- Ocean Acidification
- Precipitation
- Air Temperature
- Salinity
- Circulation
- Sea Level Rise
- Dissolved Oxygen
- Sea Ice Extent

Lettrich et al. 2019, *NMFS-F/SPO-196*

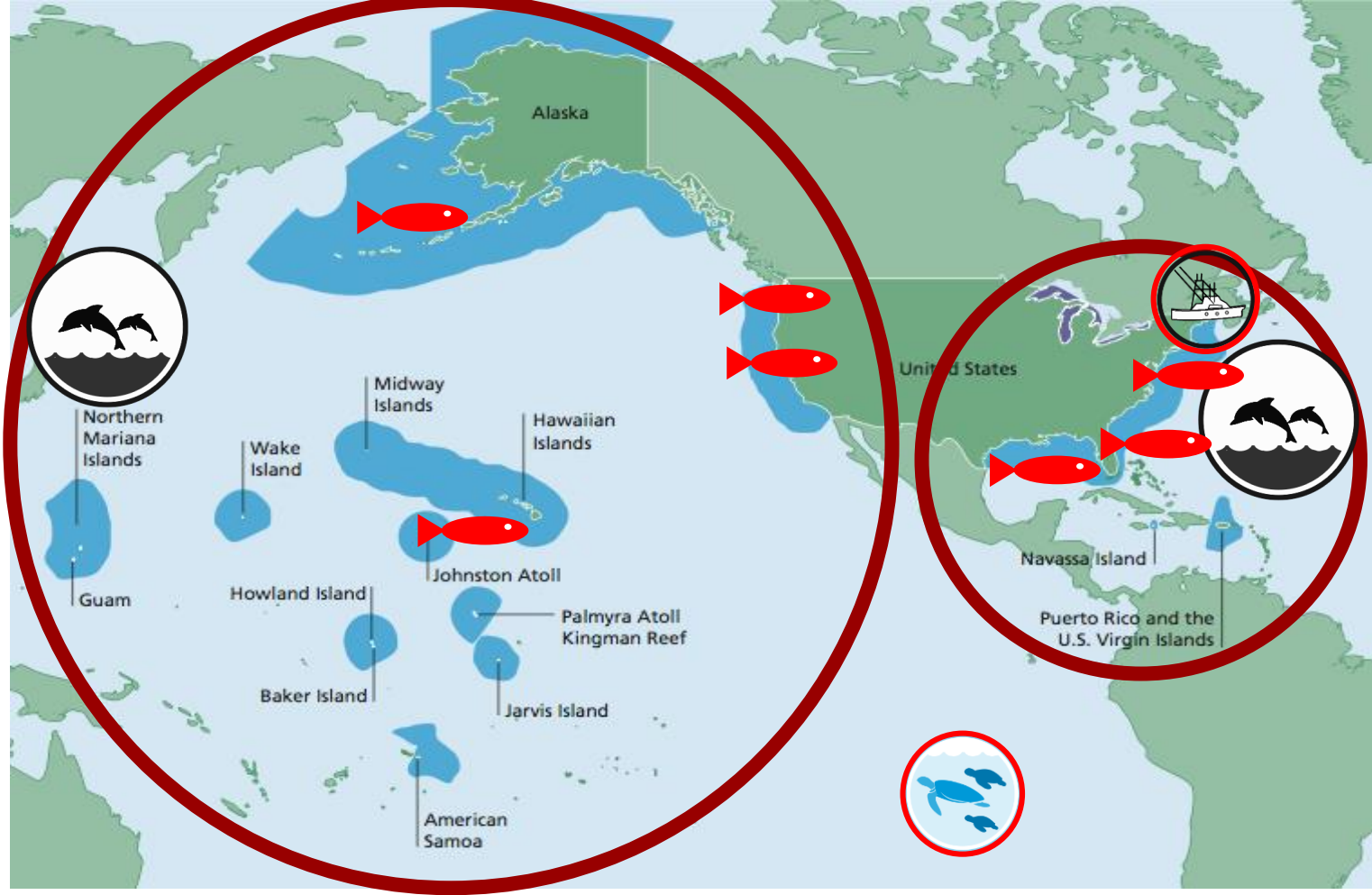
Lettrich et al. 2020, *NMFS-F/SPO-211*



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# Vulnerability Assessment Process

**Experts score populations individually and independently**



**Experts come together and discuss scores**



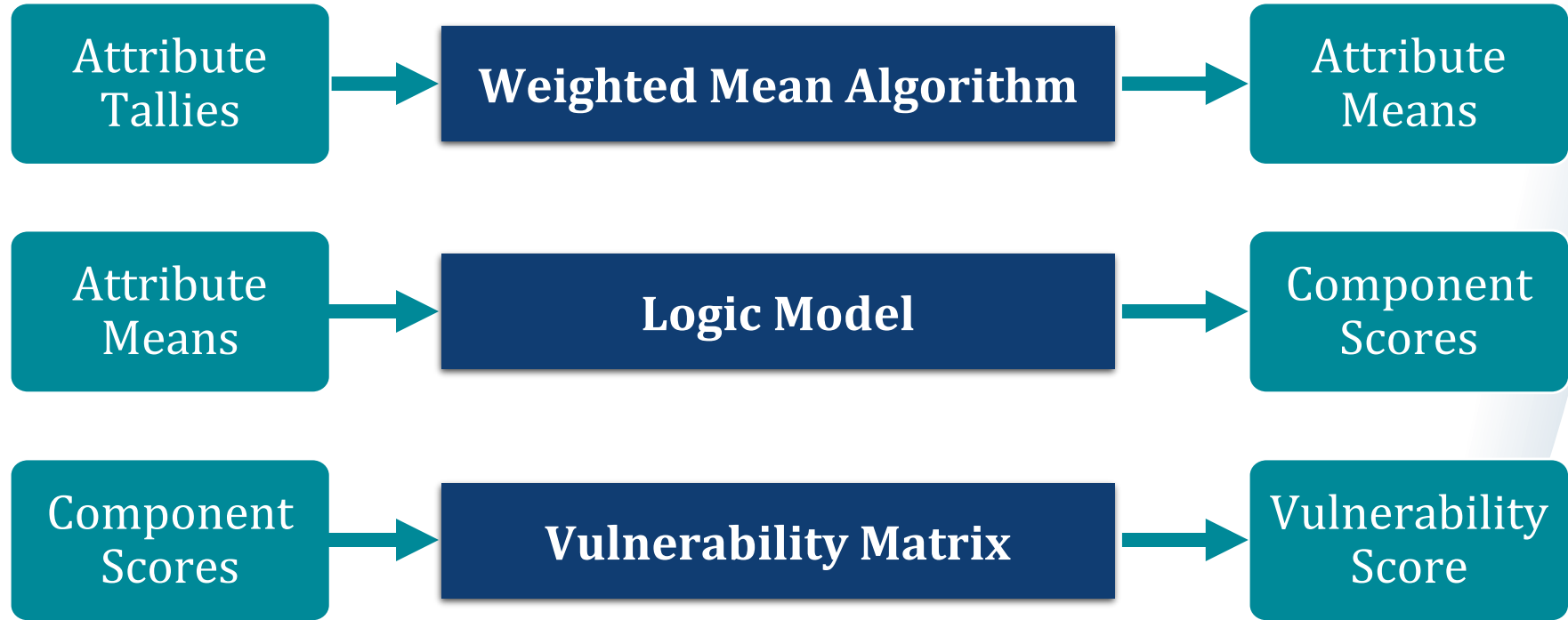
**Experts update their scores based on discussion**



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# Calculating Vulnerability Scores



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# Vulnerability Matrix

<b>Sensitivity</b>	<b>Very High (4)</b>				
	<b>High (3)</b>				
	<b>Moderate (2)</b>				
	<b>Low (1)</b>				
		<b>Low (1)</b>	<b>Moderate (2)</b>	<b>High (3)</b>	<b>Very High (4)</b>
		<b>Exposure</b>			


<b>Vulnerability</b>	
	<b>Very High</b>
	<b>High</b>
	<b>Moderate</b>
	<b>Low</b>



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West Coast, Pacific Islands, Alaska/Arctic					
Sensitivity	VH (4)			5	4
	H (3)		1	18	27
	M (2)		3	15	43
	L (1)			4	8
	L (1)	M (2)	H (3)	VH (4)	
	Exposure				

Lettrich et al. *In Prep*

East Coast, Gulf of Mexico, Caribbean					
Sensitivity	VH (4)				36
	H (3)			8	11
	M (2)		1	13	23
	L (1)		3	5	8
	L (1)	M (2)	H (3)	VH (4)	
	Exposure				

Lettrich et al. 2023, PLoS ONE  
10.1371/journal.pone.0290643



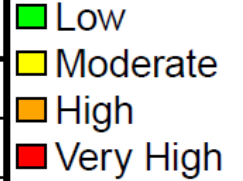
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## North Atlantic right whale

Expert Scores

Data Quality

Expert Scores Plots  
(Portion by Category)



Sensitivity attributes

Prey/Diet Specificity

3.9

3.0



Habitat Specificity

3.3

3.0



Site Fidelity

3.6

2.9



Lifetime Reproductive Potential

2.5

3.0



Generation Time

2.8

2.1



Reproductive Plasticity

3.0

3.0



Migration

1.6

2.5



Home Range

1.8

2.9



Species Abundance

3.0

3.0



Species Abundance Trend

3.4

3.0



Cumulative Stressors

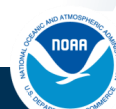
3.8

3.0



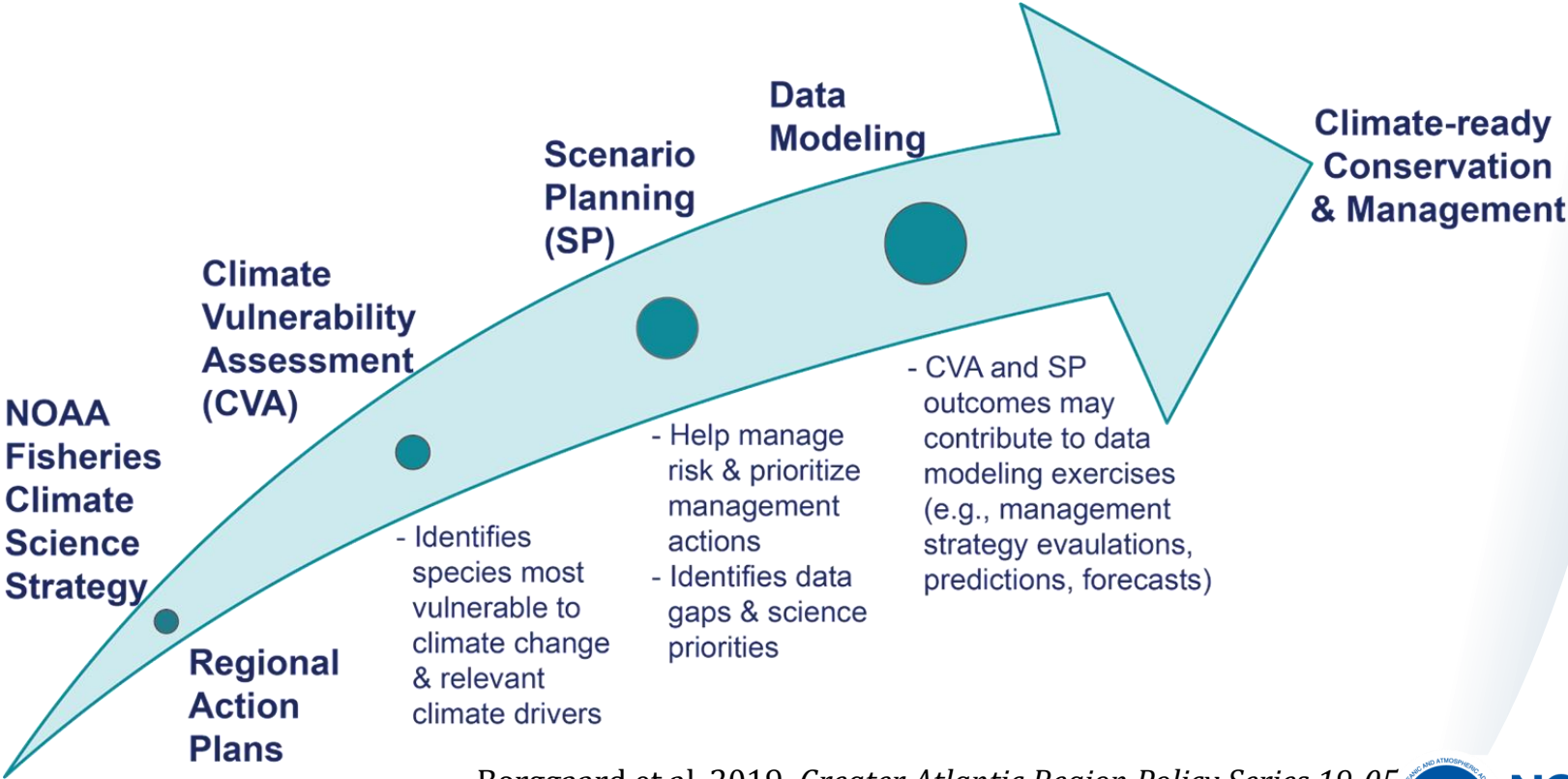
**Sensitivity Score**

**Very High**



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# How can results be used?

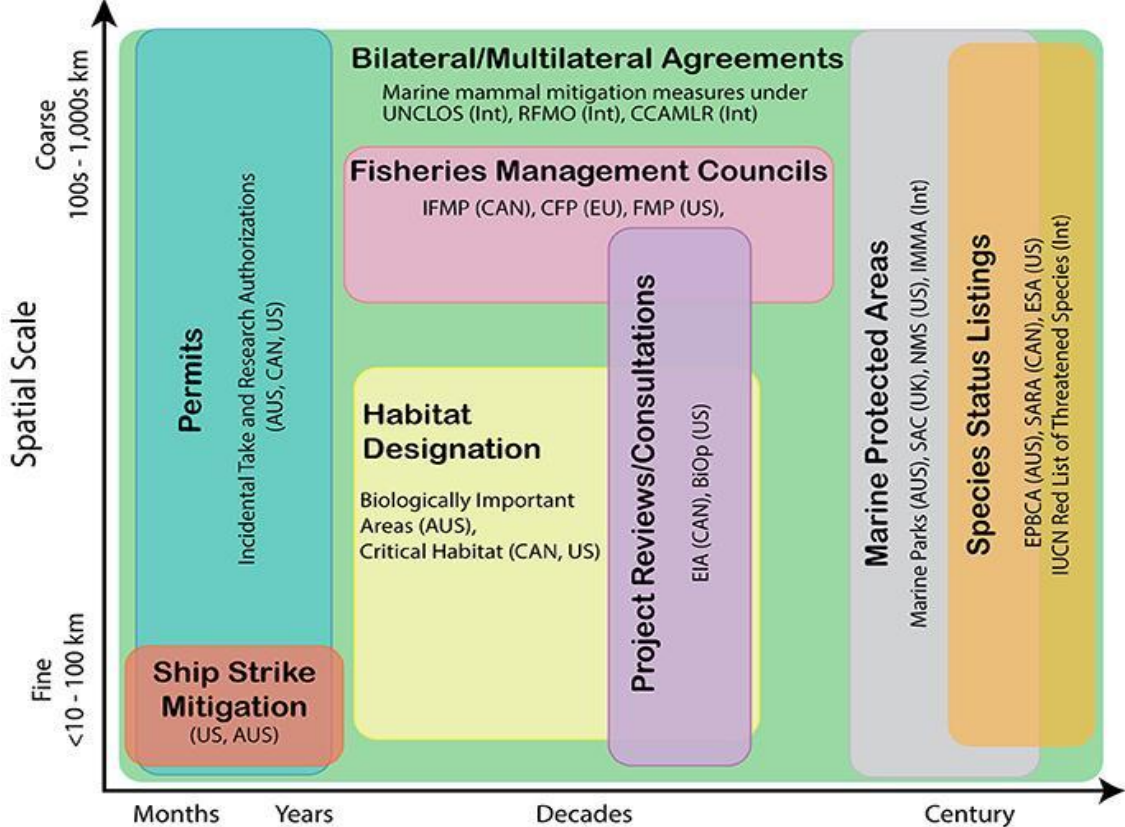


Borggaard et al. 2019, *Greater Atlantic Region Policy Series 19-05*



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# How can results be used?



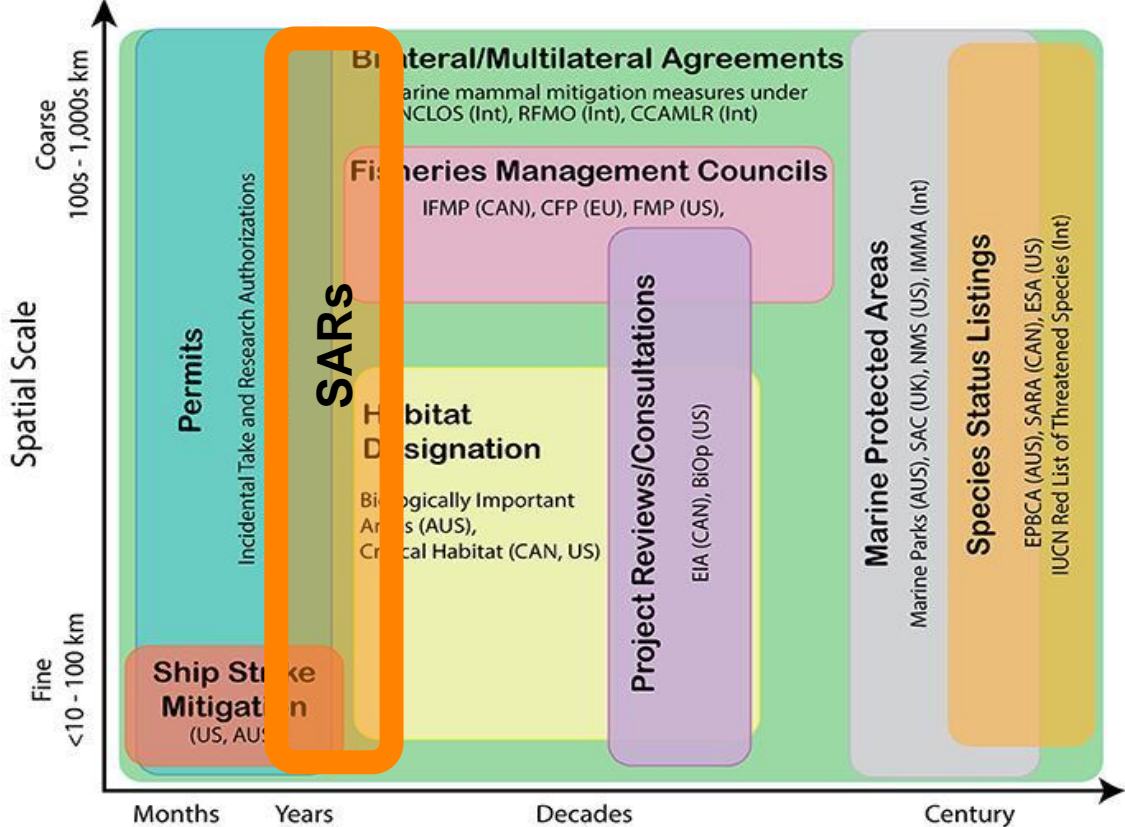
Silber et al. 2017, *Frontiers in Marine Science*

Temporal Scale



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# How can results be used?



Silber et al. 2017, *Frontiers in Marine Science*

Temporal Scale



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# Thank you!

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**NOAA Fisheries Climate Vulnerability website:**

<https://www.fisheries.noaa.gov/national/climate/climate-vulnerability-assessments>