NMFS/SEFSC South Atlantic Ecosystem Science Activities

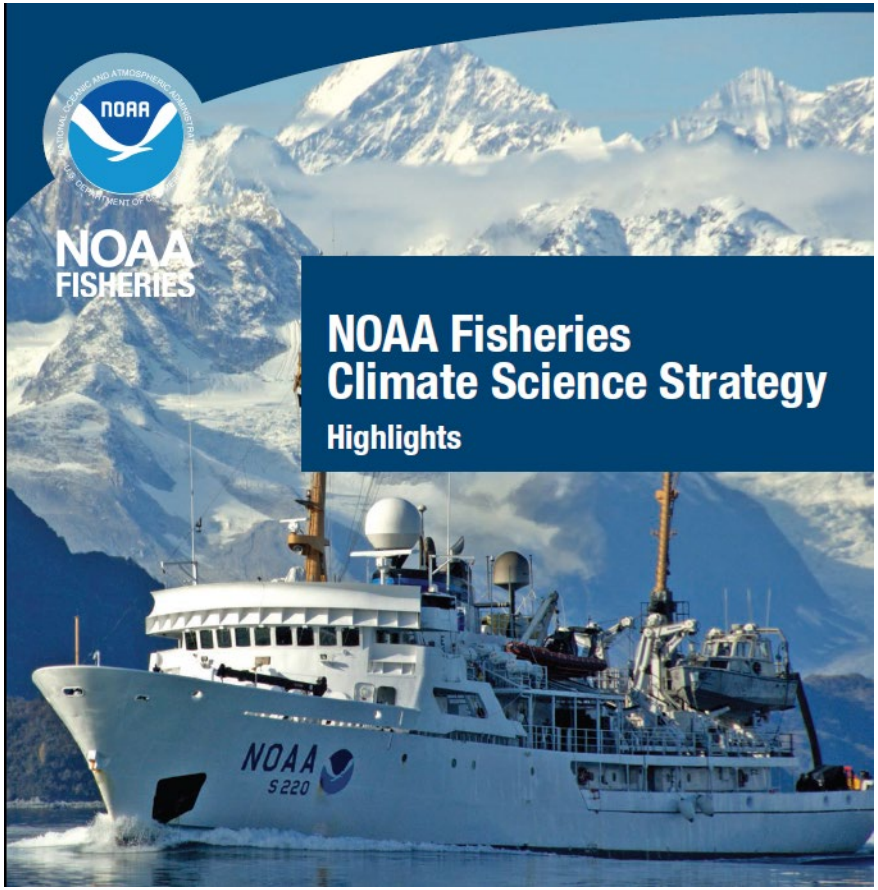
NOAA FISHERIES

Fish Climate Vulnerability Assessment An Update

April 14, 2021

Michael.Burton@noaa.gov

PRIORITY ACTIONS



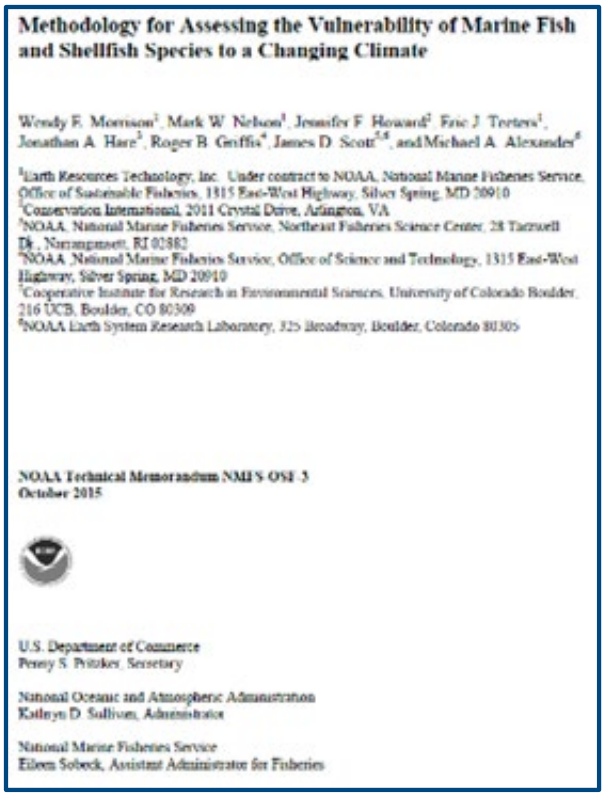
The NOAA Fisheries Climate Science Strategy identifies a series of priority near-term actions that address urgent common needs across the seven science objectives.

1. **Conduct climate vulnerability assessments on major living marine resources in each region.**
2. Produce ecosystem and socio-economic indicators and status reports to track climate-related impacts in all regions.
3. Increase the capacity to conduct management strategy evaluations that incorporate climate-related information.
4. Strengthen climate-related science capacity within each region and nationwide.
5. Develop Regional Action Plans to customize and implement the Strategy in each region over the next 3 – 5 years.
6. Increase resources for process research to better understand the mechanisms of climate impacts on living marine resources.
7. Establish climate-smart terms of reference to increase the delivery and use of climate-related information in all NOAA Fisheries mission areas.

Link, J. S., R. Griffis, and S. Busch (eds.). 2015. NOAA Fisheries Climate Science Strategy. NOAA Tech. Memo. NMFS-F/SPO-155. 82 pp. August 2015. NOAA Fisheries Office of Science and Technology. Silver Spring MD. Available at: https://www.st.nmfs.noaa.gov/Assets/ecosystems/climate/documents/NCSS_Final.pdf

Climate Vulnerability Assessment

- Also a priority under the South Atlantic Climate Science Regional Action Plan and South Atlantic EBFM Implementation Plan
- Morrison et al. 2015. Methodology for Assessing the Vulnerability of Marine Fish and Shellfish Species to a Changing Climate. NOAA Tech Memo
- Completed or underway for all NMFS regions except Caribbean



Methodology for Assessing the Vulnerability of Marine Fish and Shellfish Species to a Changing Climate

Wendy F. Morrison[1], Mark W. Nelson[1], Jennifer F. Howard[2], Eric J. Teeters[1], Jonathan A. Hare[3], Roger B. Griffis[4], James D. Scott[5,6], and Michael A. Alexander[6]

[1]Earth Resources Technology, Inc. Under contract to NOAA, National Marine Fisheries Service, Office of Sustainable Fisheries, 1315 East-West Highway, Silver Spring, MD 20910
[2]Conservation International, 2011 Crystal Drive, Arlington, VA
[3]NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, 28 Tarzwell Dr., Narragansett, RI 02882
[4]NOAA, National Marine Fisheries Service, Office of Science and Technology, 1315 East-West Highway, Silver Spring, MD 20910
[5]Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder, 216 UCB, Boulder, CO 80309
[6]NOAA Earth System Research Laboratory, 325 Broadway, Boulder, Colorado 80305

NOAA Technical Memorandum NMFS OSF 3
October 2015

U.S. Department of Commerce
Penny S. Pritzker, Secretary

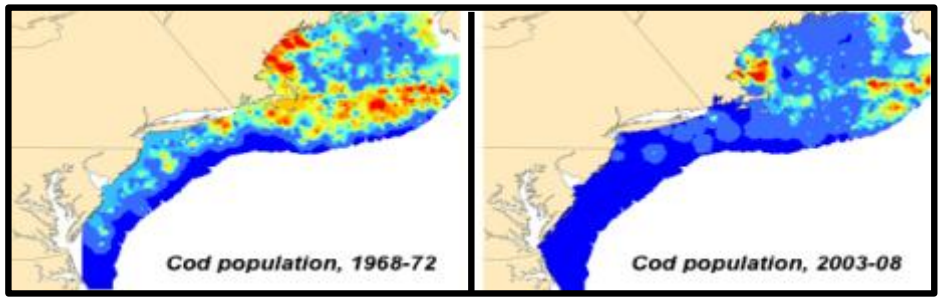
National Oceanic and Atmospheric Administration
Kathryn D. Sullivan, Administrator

National Marine Fisheries Service
Eileen Sobeck, Assistant Administrator for Fisheries

CVA – Tool to determine the likelihood that a species' productivity, abundance or distribution will be affected by a changing climate.

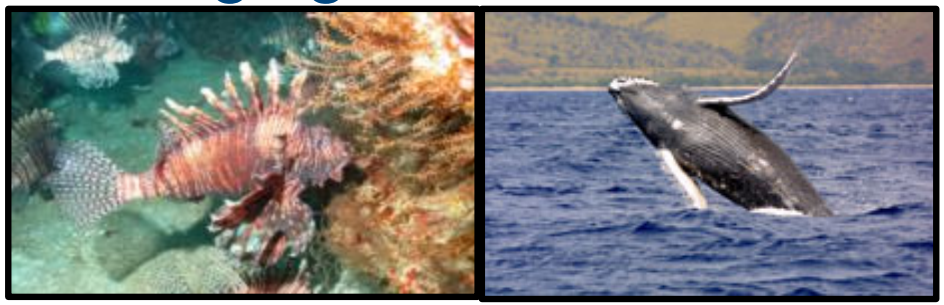
Changing Productivity

Shifting Distributions

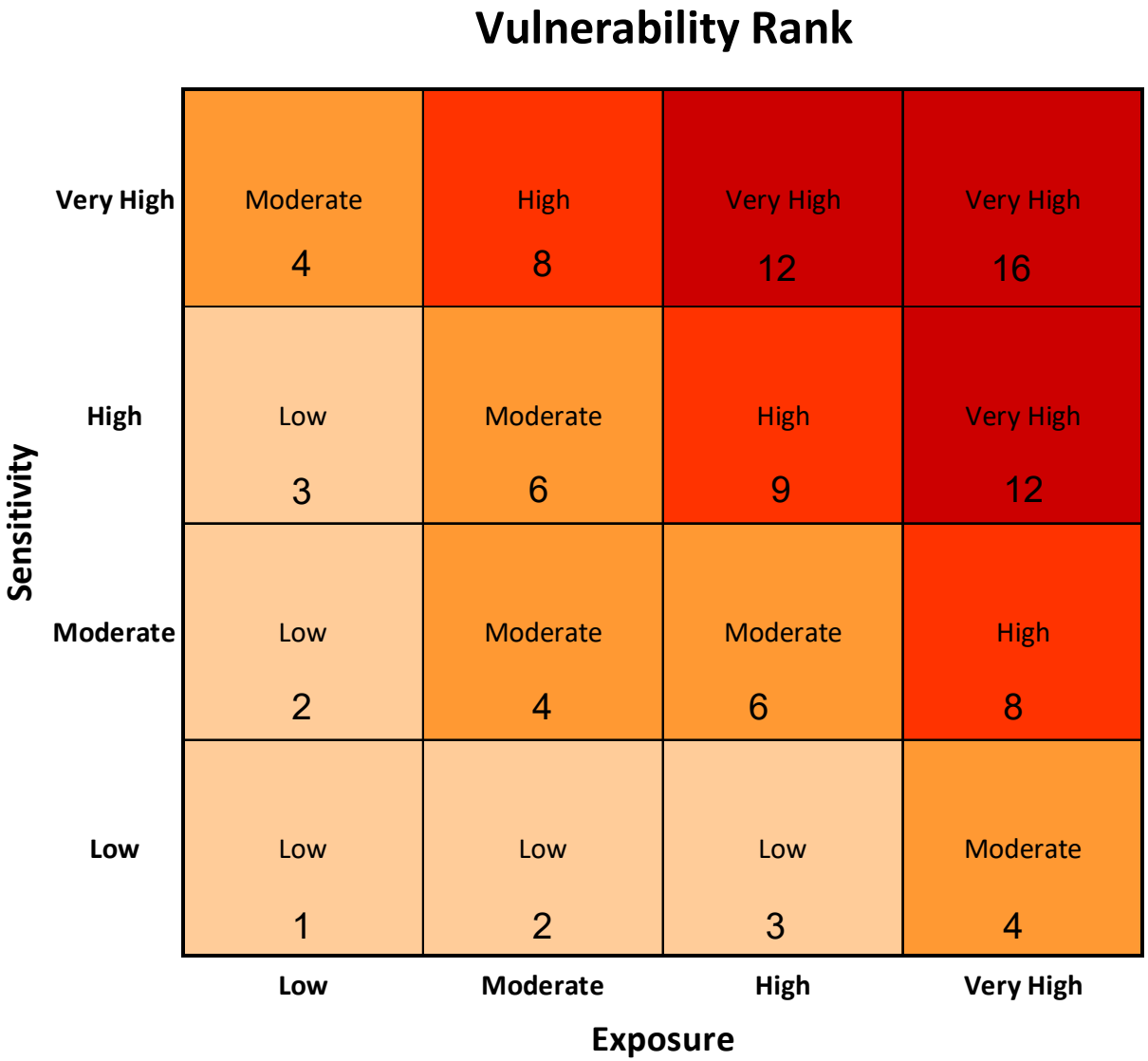


Changing Abundances

Changing Interactions



Vulnerability Scoring Rubric



Low – 1-3
Moderate – 4-6
High – 8-9
Very High – 12-16

Uncertainty in Final Vulnerability Scores

Assessed using bootstrap analysis – random sampling with replacement – 5,000 iterations

Used to find species that were borderline between two vulnerability ranks

Potential for Species Distribution Change

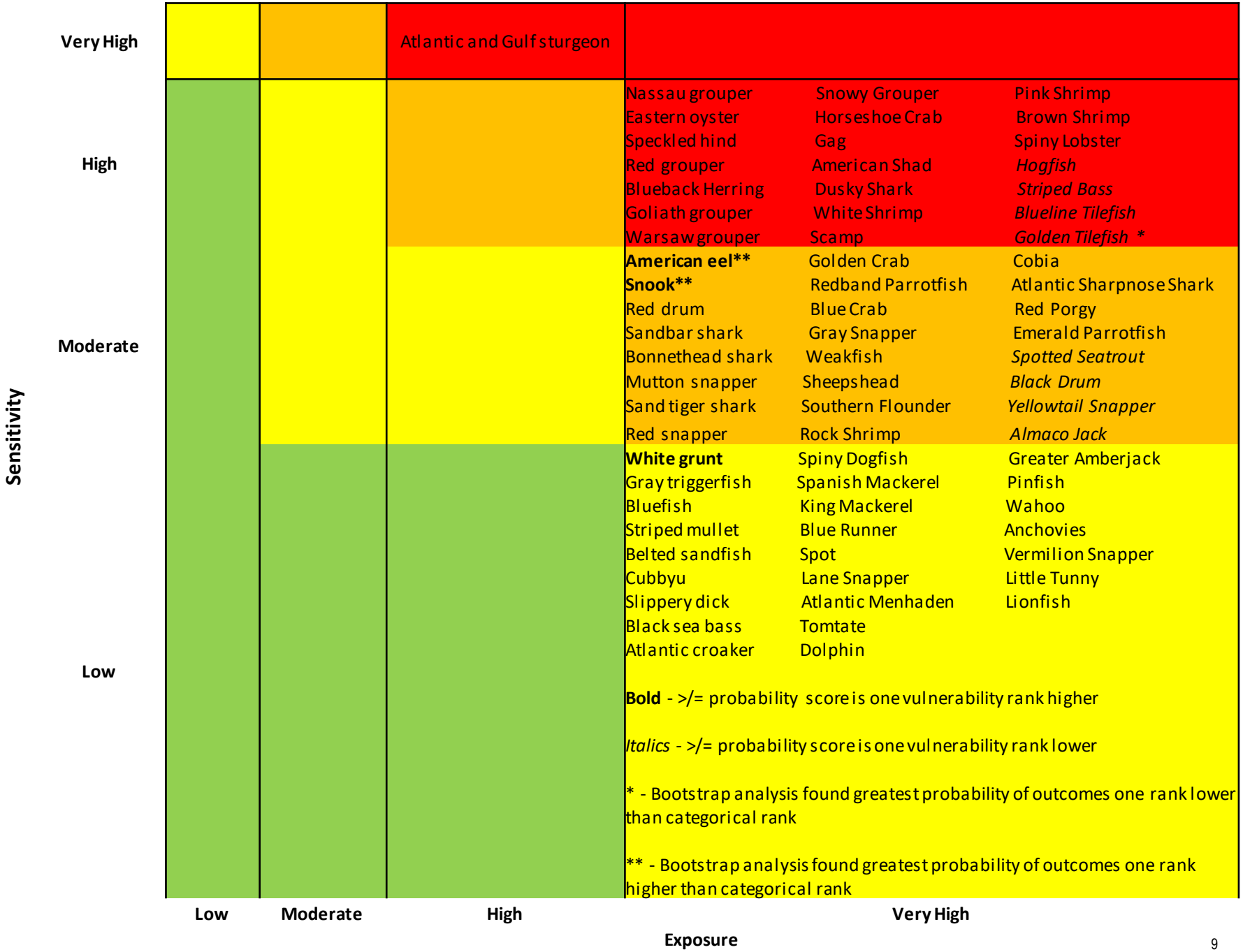
Experts were asked to assess each species for the potential to change its species distribution in response to a changing climate. This potential was based on four of the twelve sensitivity attributes:

Adult mobility
Larval dispersal
Habitat specificity
Sensitivity to Temperature

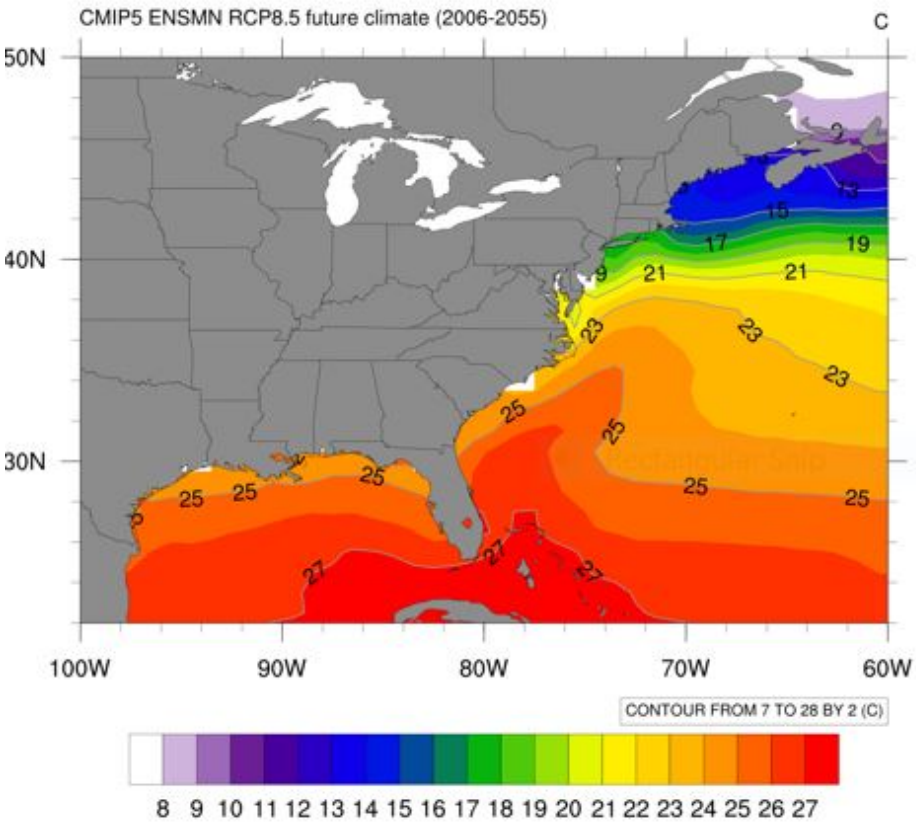
A species with high adult mobility, widespread larval dispersal, low habitat specificity and high tolerance for temperature change would be likely candidates for expanding their distributional range.

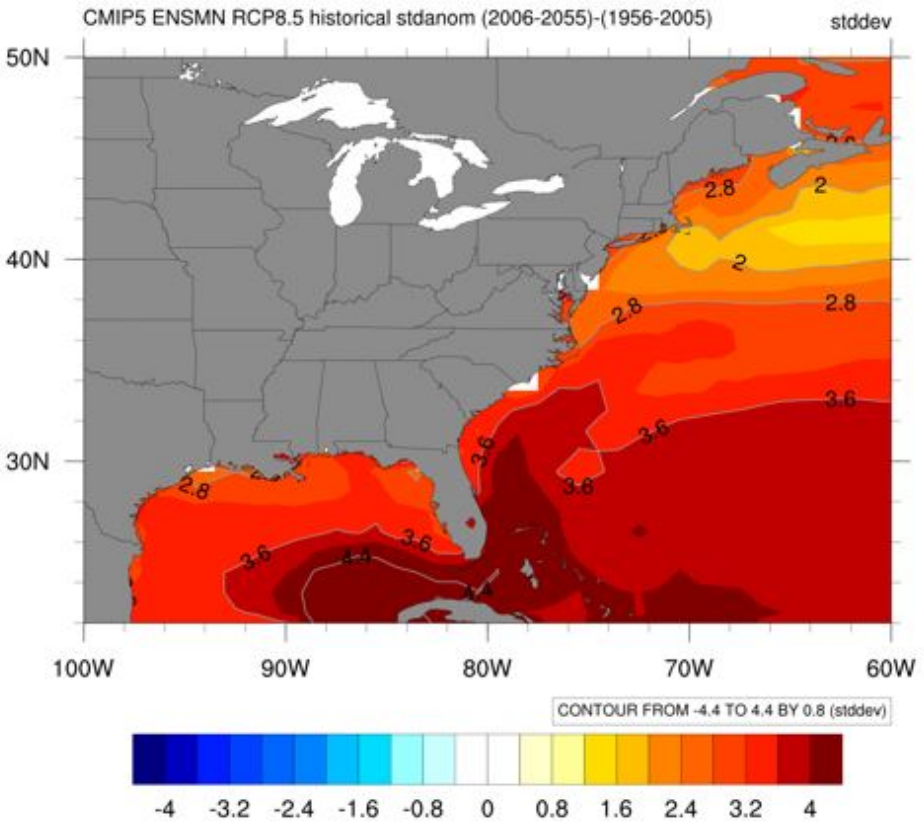
Directional Effects of Climate Change

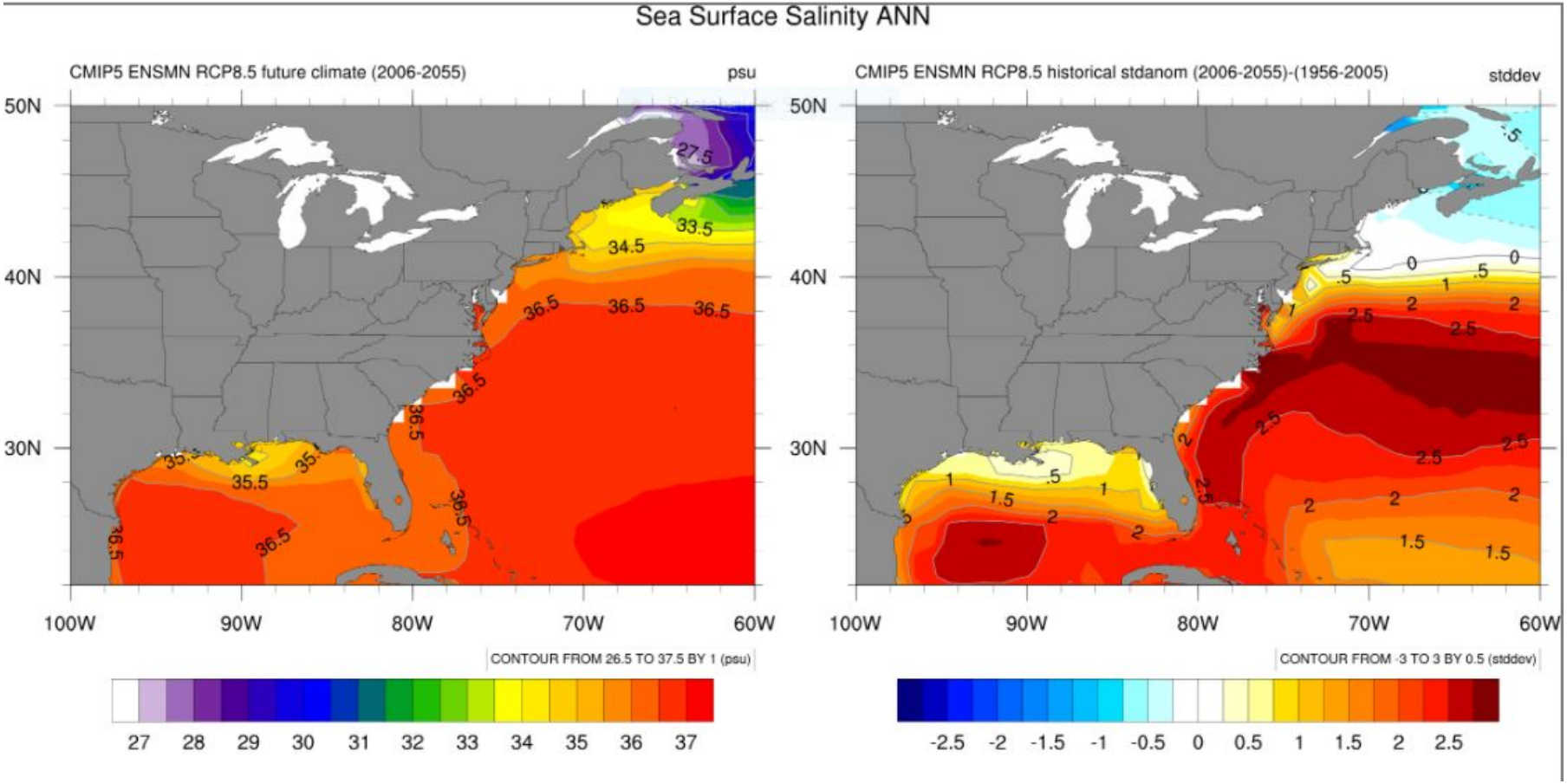
Scorers were asked to score the directional effects of climate change on each species (i.e., determine whether impacts of climate change were anticipated to be positive, neutral, or negative on the species). Each species was scored by 5 experts, who spread 4 tallies among the 3 categories (positive, neutral, negative).


Very High
High
Moderate
Low
Sensitivity
Atlantic and Gulf sturgeon
Nassau grouper
Eastern oyster
Speckled hind
Red grouper
Blueback Herring
Goliath grouper
Warsaw grouper
Snowy Grouper
Horseshoe Crab
Gag
American Shad
Dusky Shark
White Shrimp
Scamp
Pink Shrimp
Brown Shrimp
Spiny Lobster
Hogfish
Striped Bass
Blueline Tilefish
Golden Tilefish *
American eel**
Snook**
Red drum
Sandbar shark
Bonnethead shark
Mutton snapper
Sand tiger shark
Red snapper
Golden Crab
Redband Parrotfish
Blue Crab
Gray Snapper
Weakfish
Sheepshead
Southern Flounder
Rock Shrimp
Cobia
Atlantic Sharpnose Shark
Red Porgy
Emerald Parrotfish
Spotted Seatrout
Black Drum
Yellowtail Snapper
Almaco Jack
White grunt
Gray triggerfish
Bluefish
Striped mullet
Belted sandfish
Cubbyu
Slippery dick
Black sea bass
Atlantic croaker
Spiny Dogfish
Spanish Mackerel
King Mackerel
Blue Runner
Spot
Lane Snapper
Atlantic Menhaden
Tomtate
Dolphin
Greater Amberjack
Pinfish
Wahoo
Anchovies
Vermilion Snapper
Little Tunny
Lionfish
Bold - >/= probability score is one vulnerability rank higher
Italics - >/= probability score is one vulnerability rank lower
* - Bootstrap analysis found greatest probability of outcomes one rank lower than categorical rank
** - Bootstrap analysis found greatest probability of outcomes one rank higher than categorical rank
Low
Moderate
High
Very High
Exposure

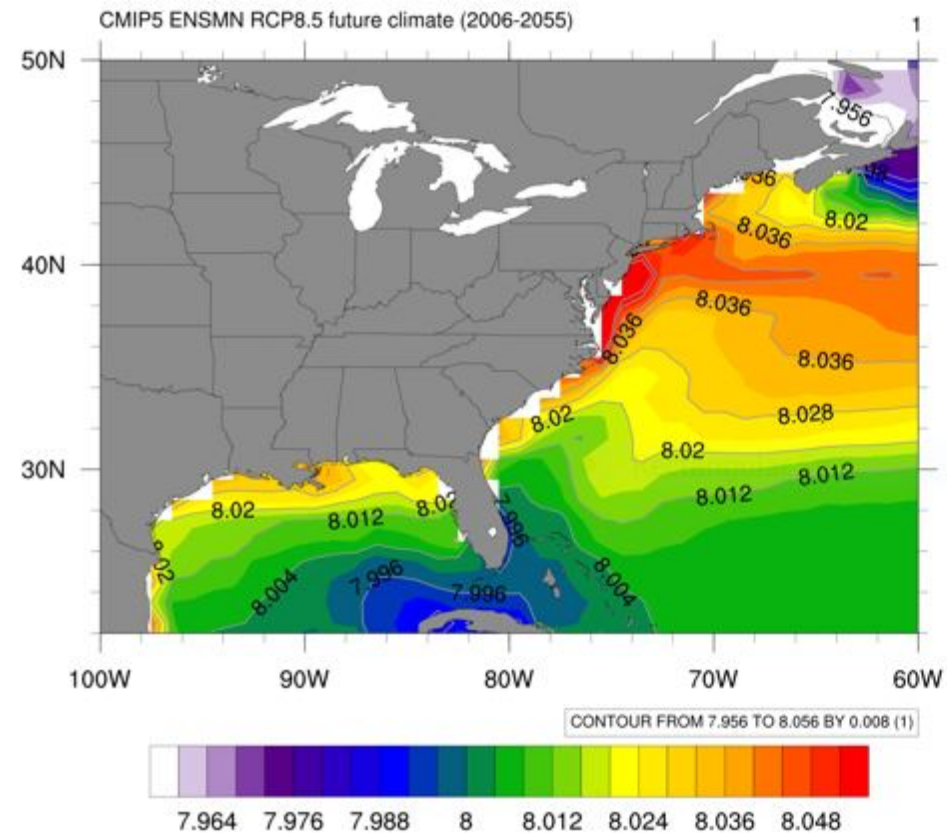
Sea Surface Temperature ANN

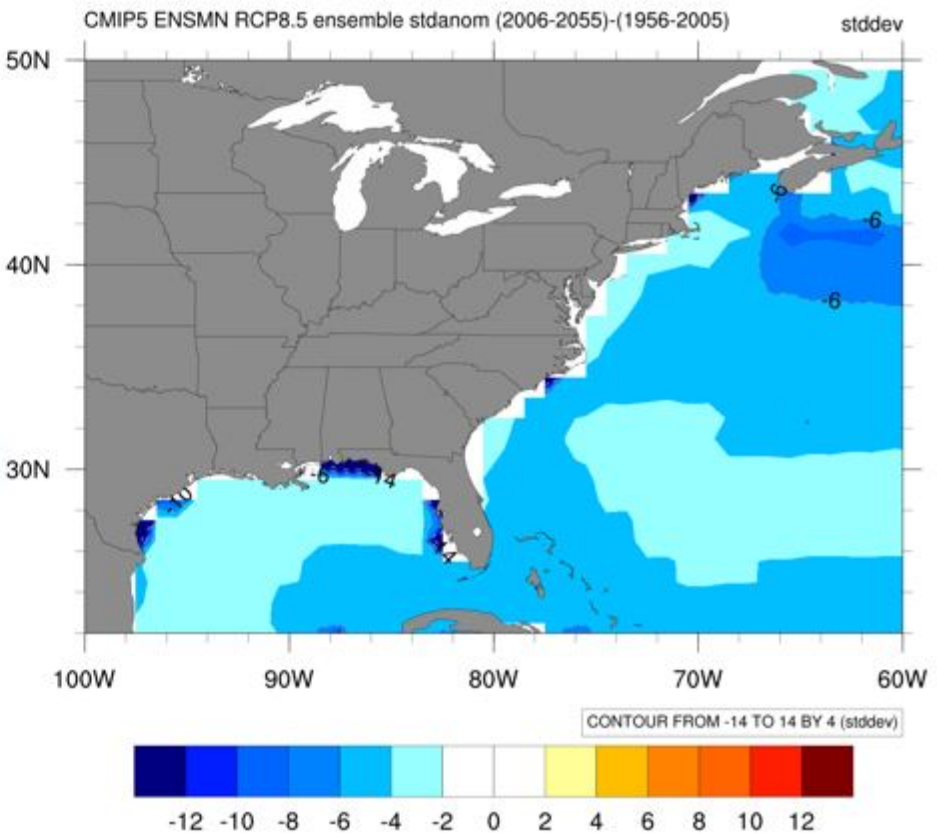




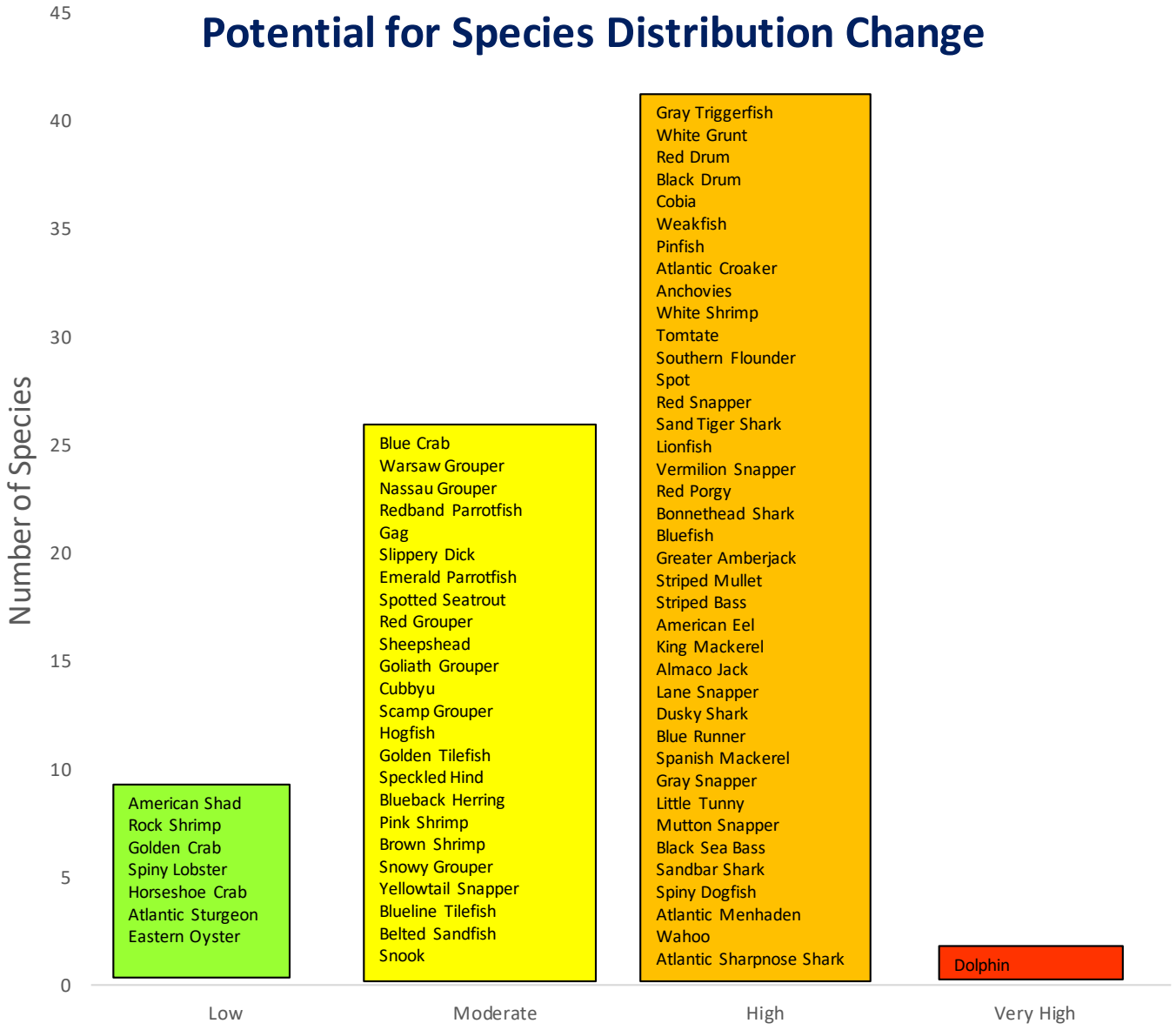

Sea Surface Salinity ANN
CMIP5 ENSMN RCP8.5 future climate (2006-2055)
psu
CMIP5 ENSMN RCP8.5 historical stdanom (2006-2055)-(1956-2005)
stddev
50N
40N
30N
100W
90W
80W
70W
60W
CONTOUR FROM 26.5 TO 37.5 BY 1 (psu)
27 28 29 30 31 32 33 34 35 36 37
CONTOUR FROM -3 TO 3 BY 0.5 (stddev)
-2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5

pH at Surface ANN

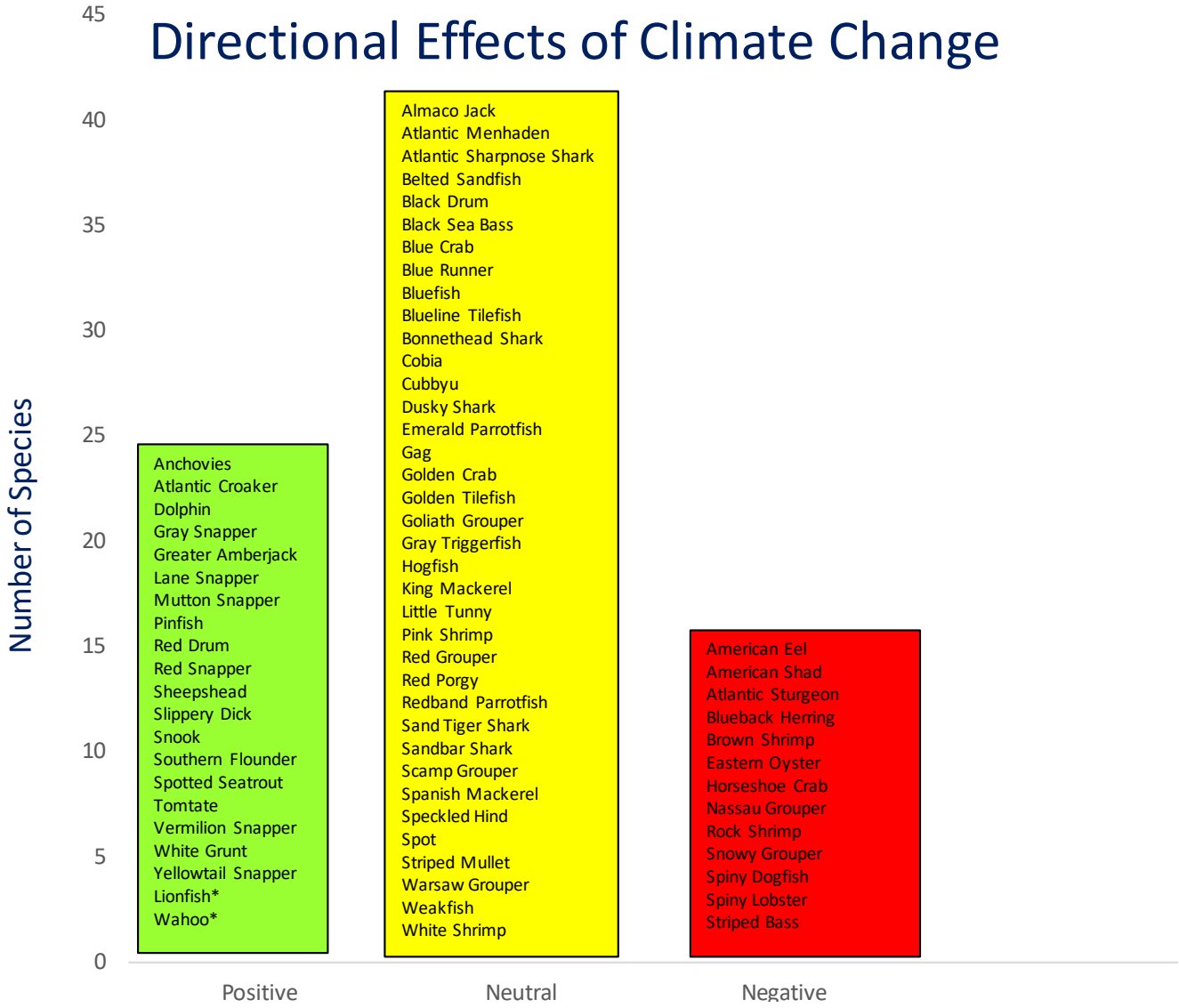


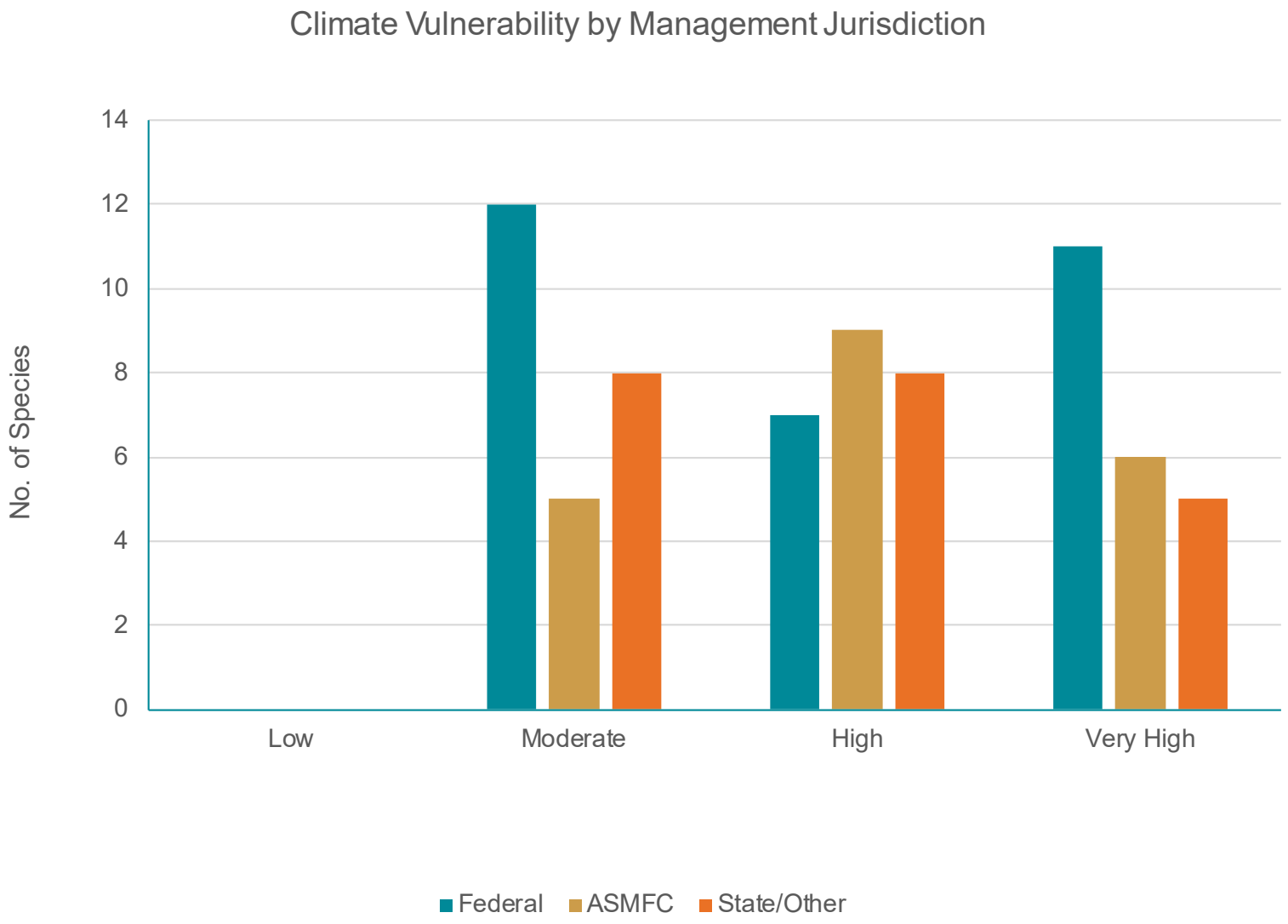


Potential for Species Distribution Change



Directional Effects of Climate Change




Climate Vulnerability by Management Jurisdiction
No. of Species
14
12
10
8
6
4
2
0
Low
Moderate
High
Very High
Federal
ASMFC
State/Other

Key Points

- Most Impactful Exposure Factors – SST, Salinity*, Ocean Acidification
- 22 species VH - Anadromous, Invertebrates, Deep-water Demersals
- 24 species H - Coastal and Reef Fishes
- 25 species M - Pelagics, Forage, Coastal and Reef Fishes
- Species also spread across management jurisdictions
- Distribution Change – Majority have VH or H potential for change
- Directional effects
  - Majority positive/neutral effect from climate change
  - Anadromous, Invertebrates and Deep-water Demersal Fishes negative
- CVAs intended to be conducted iteratively, can be updated in future yrs.

*Salinity Anomaly – Climate change predicted to enhance the global water cycle, wet regions will get wetter and dry regions dryer. Subtropical ocean regions (dry to start with) projected to warm and enhance evaporation.

Remaining Steps

- Complete Species Narratives – Ongoing
- Manuscript Preparation - Ongoing
- Final Report – Pending

How can CVA be used by SAFMC?

Risk assessments such as CVA can be used to prioritize EAFM analyses and research plans for future years:
https://www.frontiersin.org/articles/10.3389/fmars.2018.00442/full

Climate Change Scenario Planning – Multi-Region, Multi-Council effort

e.g. – MAFMC used Ecosystem Status Report to identify indicators for Risk Elements: Ecological, Social, Community, Management, Food Production

Each indicator was scored from Low to High Risk in order to rank the highest risk issues

CVA rankings were applied directly as risk ranking criteria
https://www.mafmc.org/actions/climate-change-scenario-planning

Thank you!

Questions?