Monitoring Biodiversity Exposure Risks to Global Change

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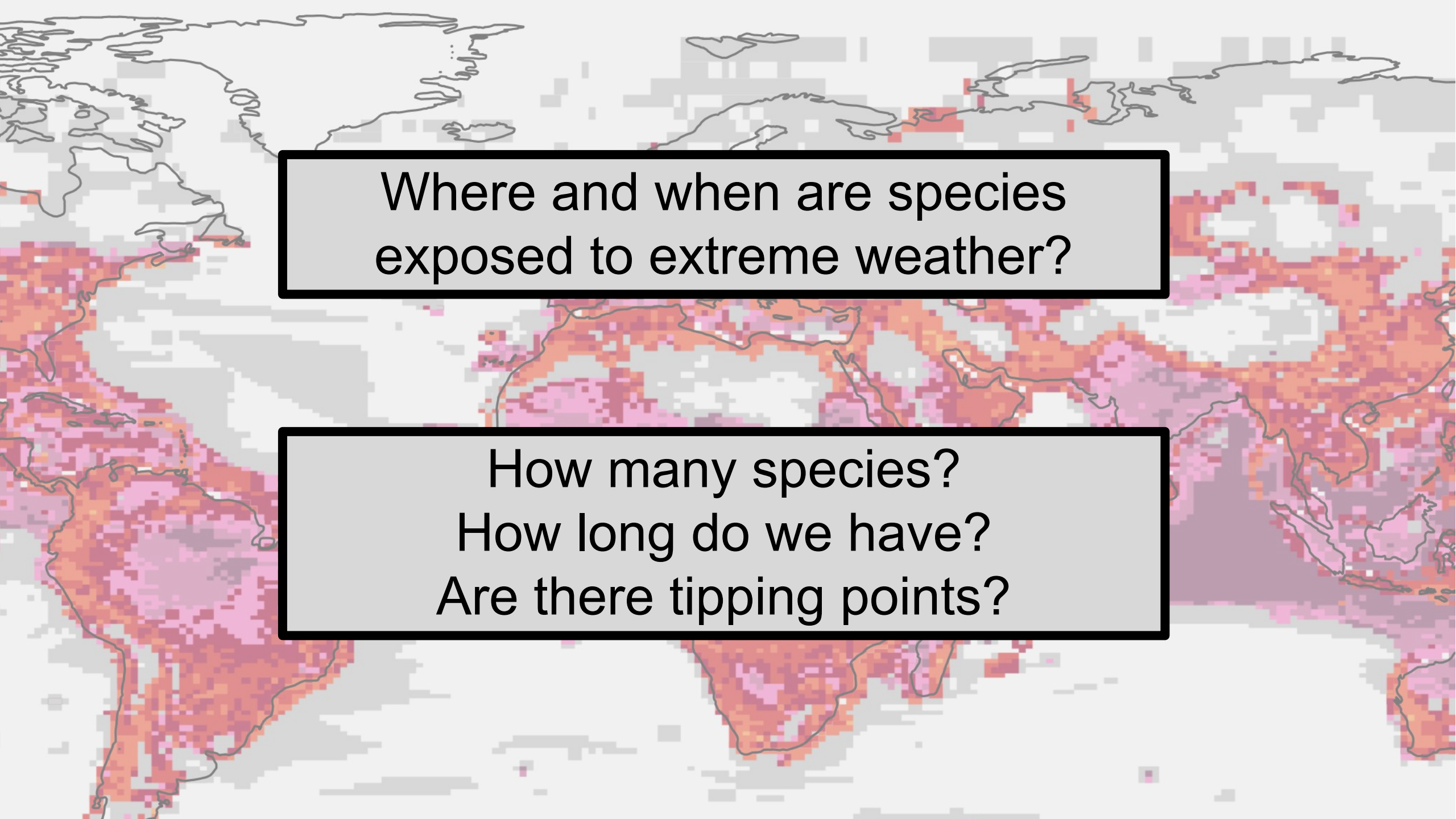
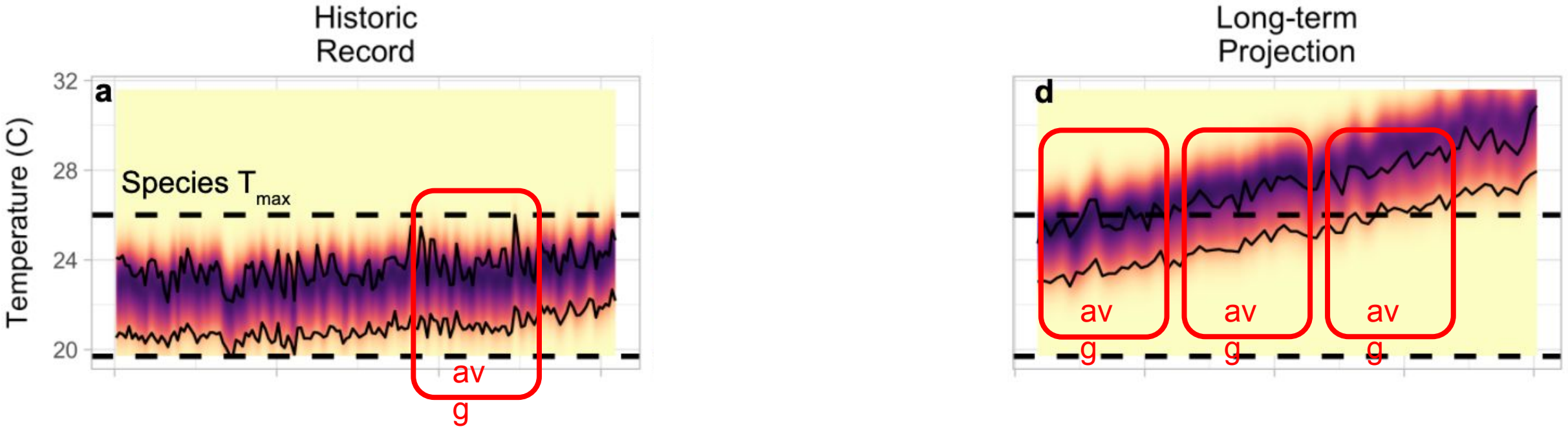
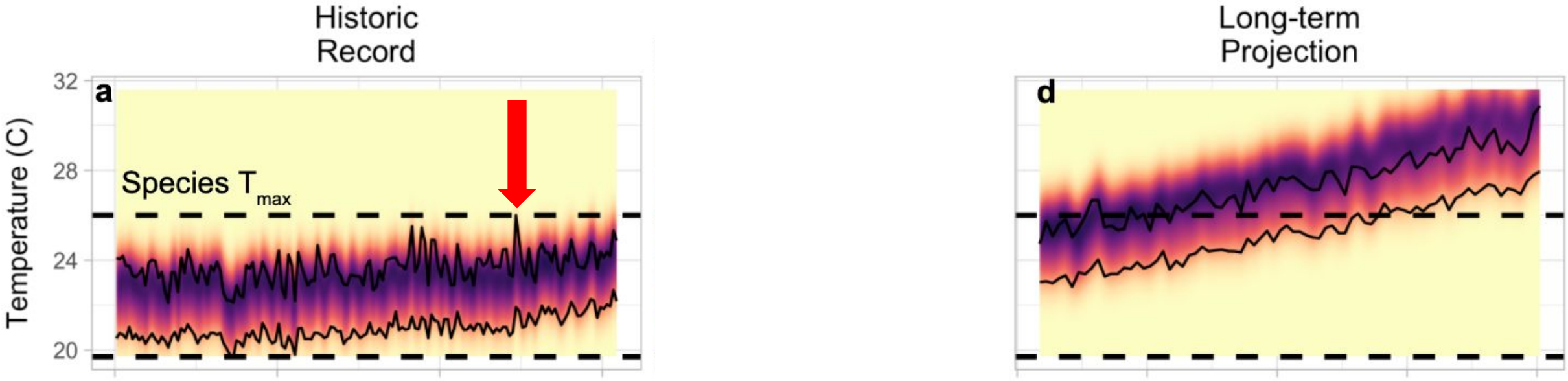

Where and when are species exposed to extreme weather?
How many species?
How long do we have?
Are there tipping points?

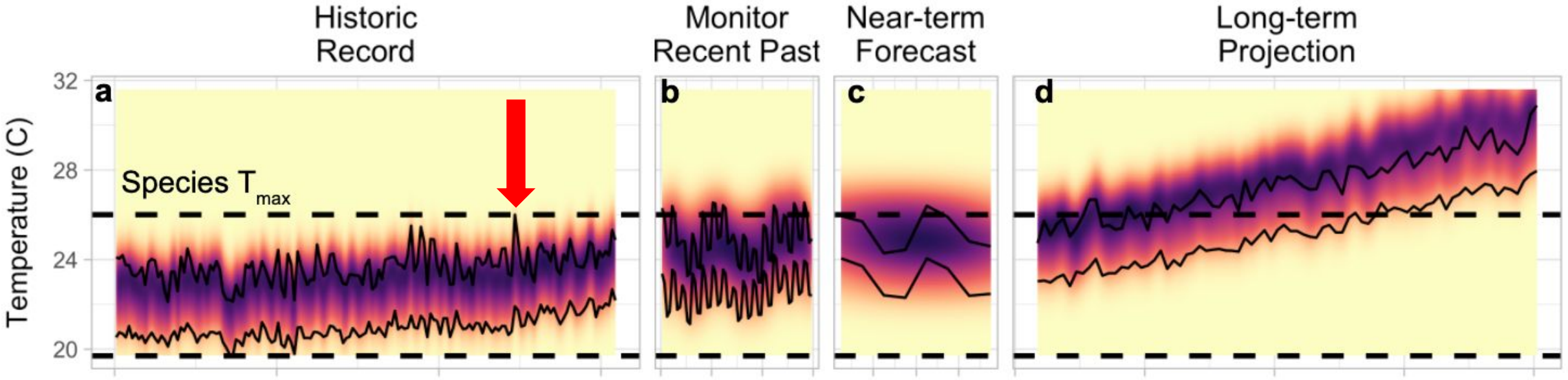
Monitoring exposure across species' ranges

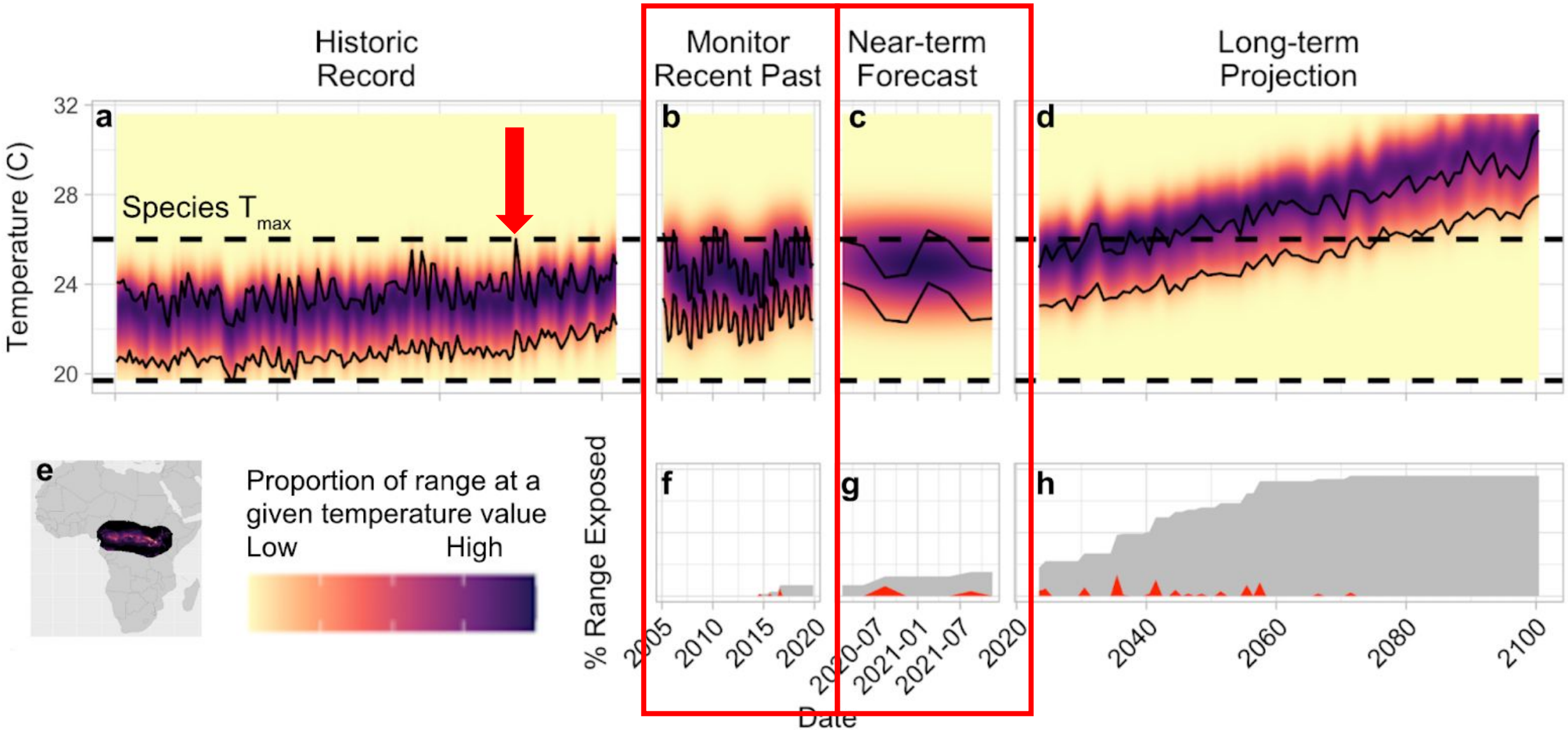


Monitoring exposure across species' ranges

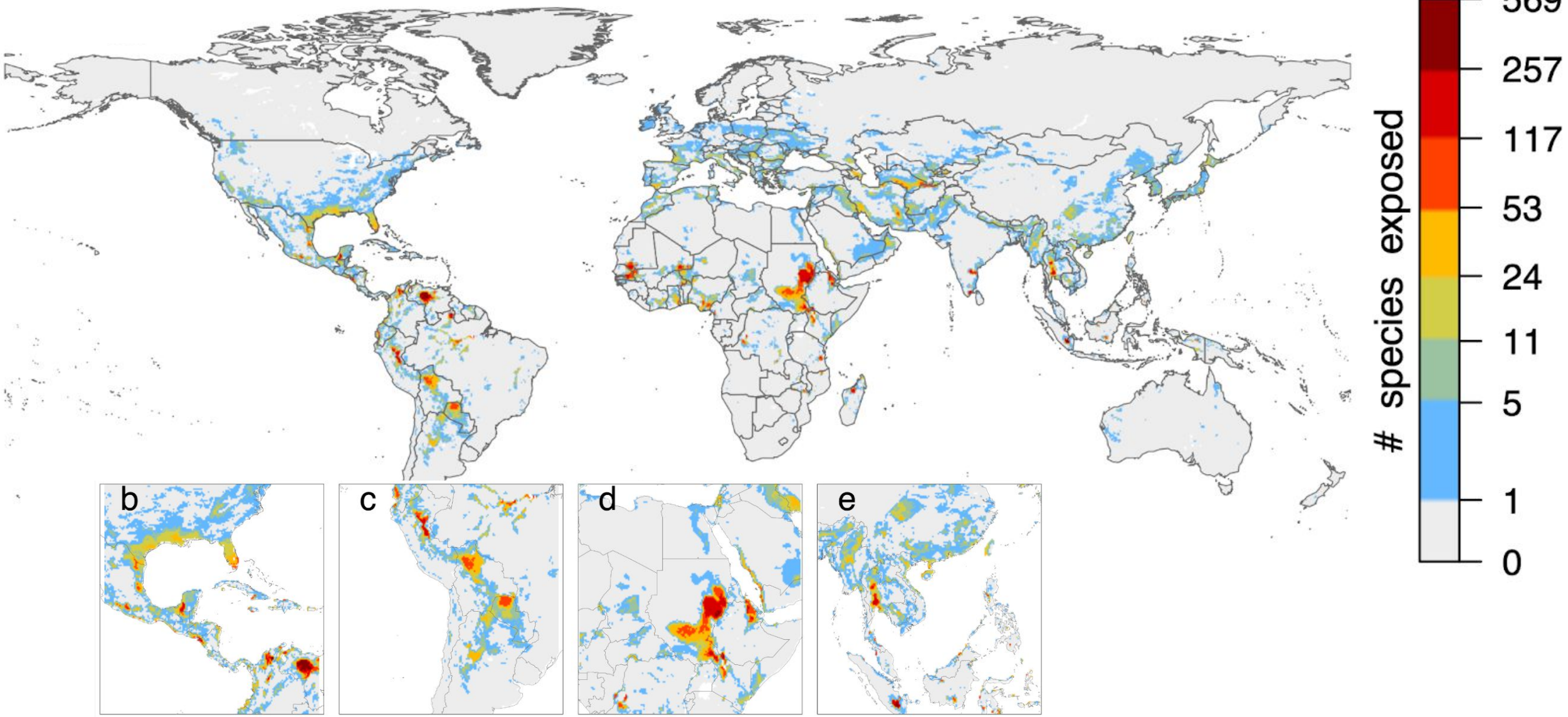


Monitoring exposure across species' ranges

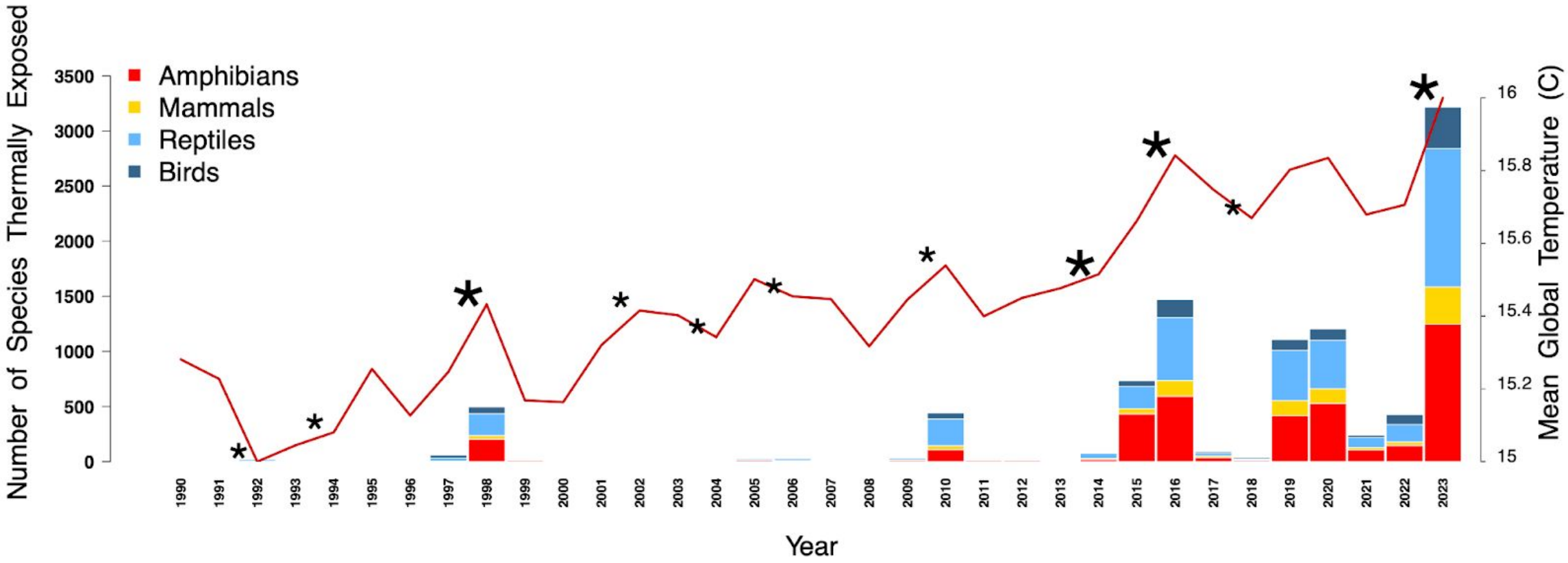



Historic Record
Monitor Recent Past
Near-term Forecast
Long-term Projection
a
b
c
d
Temperature (C)
32
28
24
20
Species T max
e
Proportion of range at a given temperature value
Low
High
f
g
h
% Range Exposed
2005
2010
2015
2020
2020-07
2021-01
2021-07
2020
2040
2060
2080
2100
Date

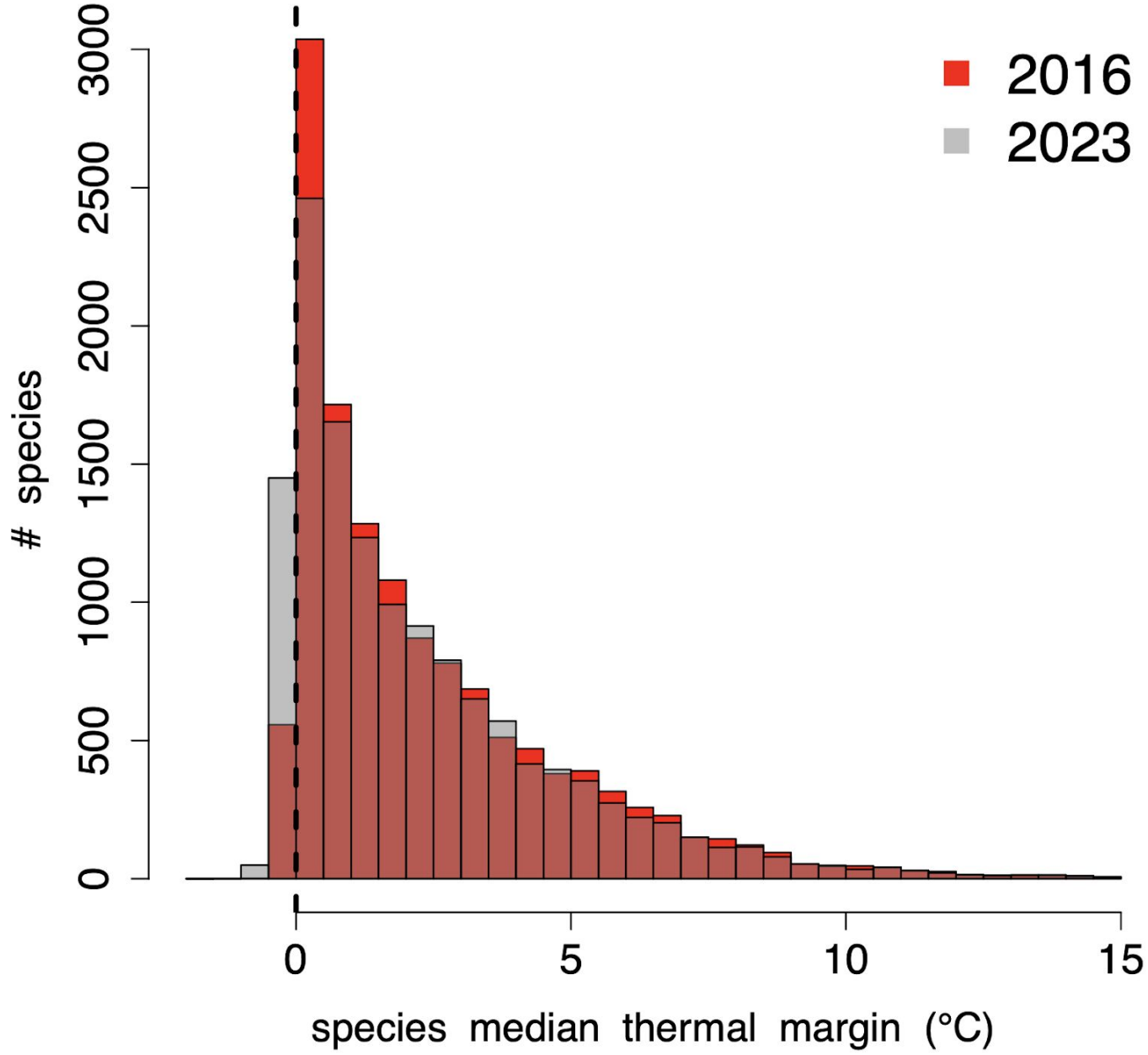
Unprecedented heat threatened 1 in 12 vertebrate species in 2023

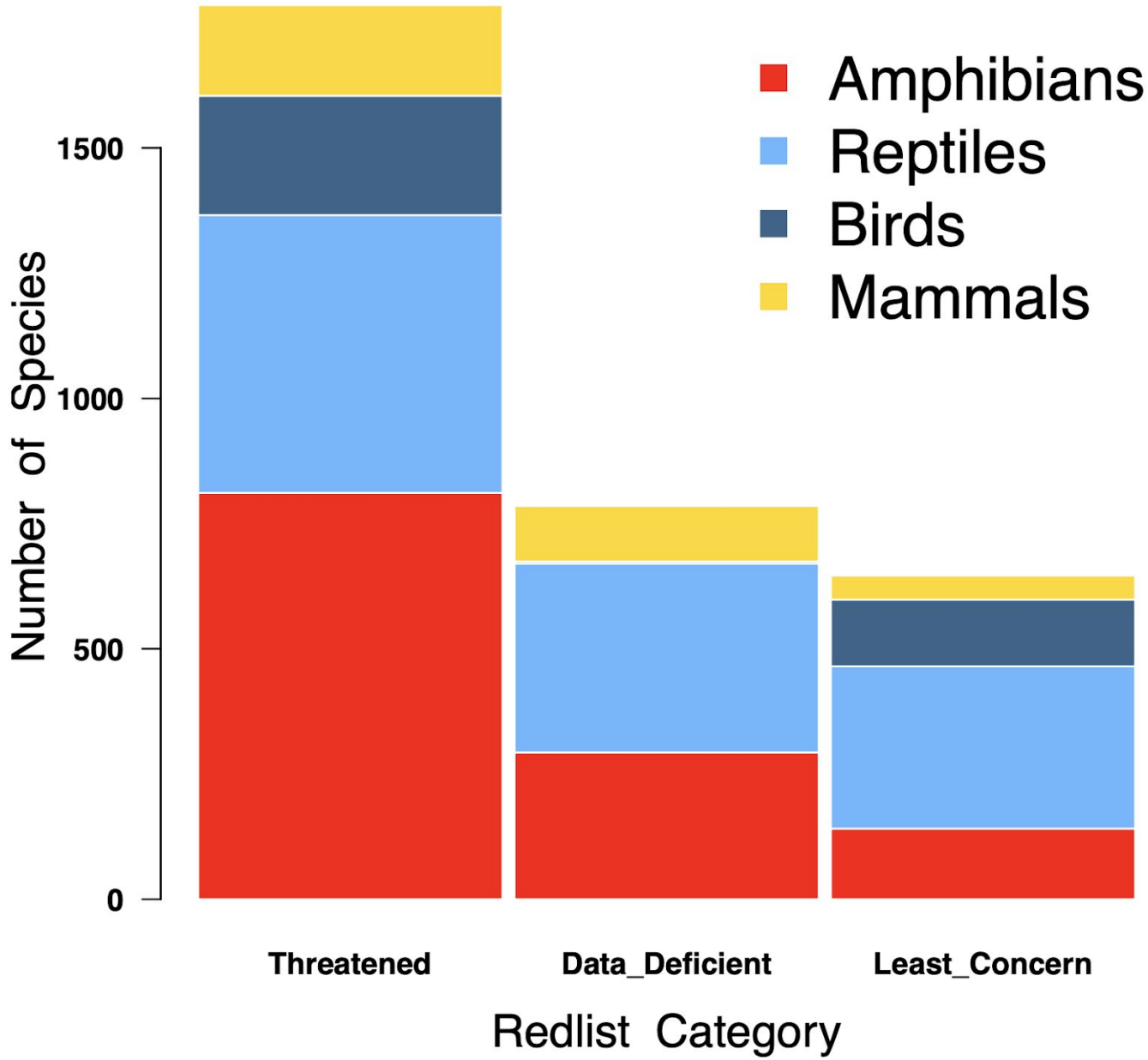


2023 Vertebrate exposure



We're near a tipping point...




Amphibians
Reptiles
Birds
Mammals
Number of Species
1500
1000
500
0
Threatened
Data_Deficient
Least_Concern
Redlist Category

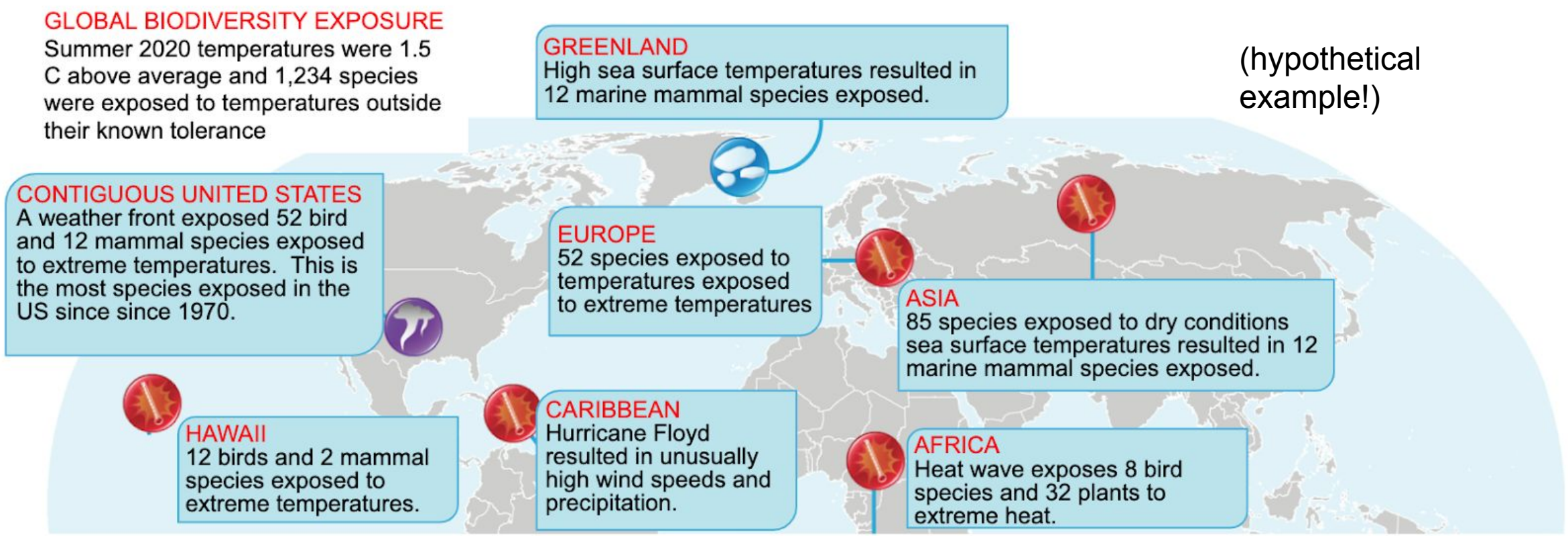
Priorities

	spName	rangeSize.y	group.y	realm.y	ECO_NAME.y
1	Anguis_incomptus	4	reptiles	Neotropical	Veracruz moist forests
2	Chikila_fulleri	1	amphibians	Indomalayan	Mizoram-Manipur-Kachin rain forests
3	Ctenomys_knighti	3	mammals	Neotropical	High Monte
4	Ctenomys_knighti	3	mammals	Neotropical	Southern Andean Yungas
5	Ctenomys_knighti	3	mammals	Neotropical	Dry Chaco
6	Cyrtodactylus_martini	1	reptiles	Indomalayan	Northern Indochina subtropical forests
7	Gastrotheca_chrysosticta	3	amphibians	Neotropical	Southern Andean Yungas
8	Geomys_tropicalis	3	mammals	Neotropical	Veracruz moist forests
9	Lycodon_synaptor	4	reptiles	Indomalayan	Yunnan Plateau subtropical evergreen forests
10	Micrurus_tamaulipensis	1	reptiles	Nearctic|Neotropical	Veracruz moist forests
11	Ophiomorus_chernovi	2	reptiles	Palearctic	Kopet Dag woodlands and forest steppe
12	Pristimantis_viridis	2	amphibians	Neotropical	Northwest Andean montane forests
13	Pristurus_longipes	1	reptiles	Afrotropical|Palearctic	Southwest Arabian coastal xeric shrublands
14	Rhinella_bernardoi	2	amphibians	Neotropical	High Monte
15	Rhinella_bernardoi	2	amphibians	Neotropical	Low Monte
16	Thamnodynastes_ceibae	1	reptiles		Maracaibo dry forests
17	Tylototriton_sparreboomi	4	amphibians	Indomalayan	Northern Indochina subtropical forests
18	Tympanoctomys_loschalchalerosorum	2	mammals	Neotropical	Dry Chaco

	Ecoregi				
1	Madaga				
2	Madaga				
3	Vogelkc				
4	Sulawes				
5	Andam				
6	Borneo				
7	Sierra M				
8	Northw				
9	Northw				
10	Peruvia				
11	Palau t				
12	Palau t				
13	Guizhou				
14	Northwest Russian-Novaya Zemlya tundra	CHARADRIIFORMES	10	1	Palearctic
15	Sarmatic mixed forests	CHARADRIIFORMES	10	1	Palearctic
16	Scandinavian Montane Birch forest and grasslands	CHARADRIIFORMES	10	1	Palearctic
17	Scandinavian and Russian taiga	CHARADRIIFORMES	10	1	Palearctic
18	Scandinavian coastal conifer forests	CHARADRIIFORMES	10	1	Palearctic

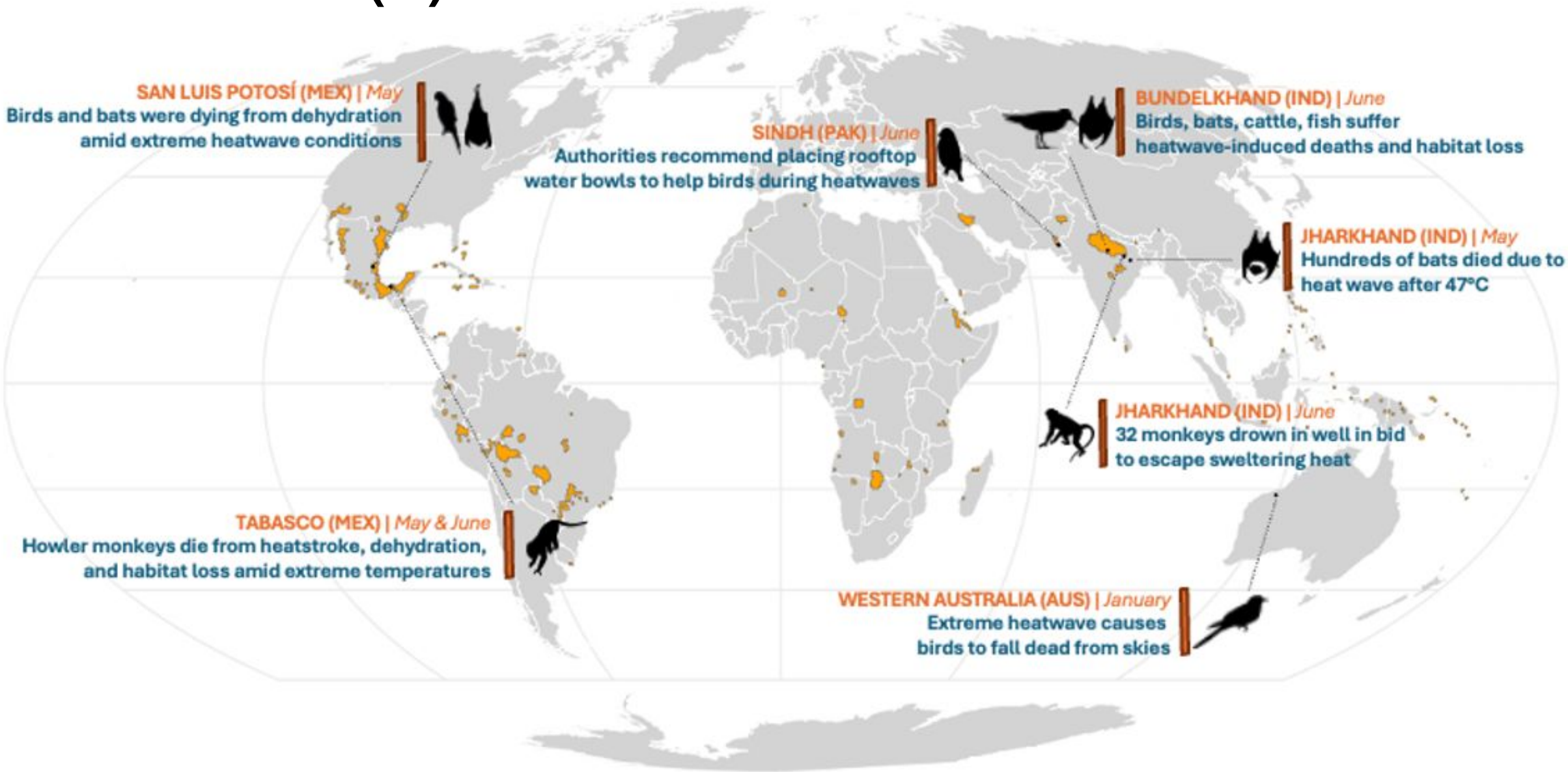
Soon: Monitoring Exposure Events

Significant 2024 Biodiversity Exposure Events



(hypothetical example!)

Validation(?)


SAN LUIS POTOSÍ (MEX) | May
Birds and bats were dying from dehydration amid extreme heatwave conditions
SINDH (PAK) | June
Authorities recommend placing rooftop water bowls to help birds during heatwaves
BUNDELKHAND (IND) | June
Birds, bats, cattle, fish suffer heatwave-induced deaths and habitat loss
JHARKHAND (IND) | May
Hundreds of bats died due to heat wave after 47°C
JHARKHAND (IND) | June
32 monkeys drown in well in bid to escape sweltering heat
TABASCO (MEX) | May & June
Howler monkeys die from heatstroke, dehydration, and habitat loss amid extreme temperatures
WESTERN AUSTRALIA (AUS) | January
Extreme heatwave causes birds to fall dead from skies

2024: Hottest year in recorded history compounds global biodiversity risks

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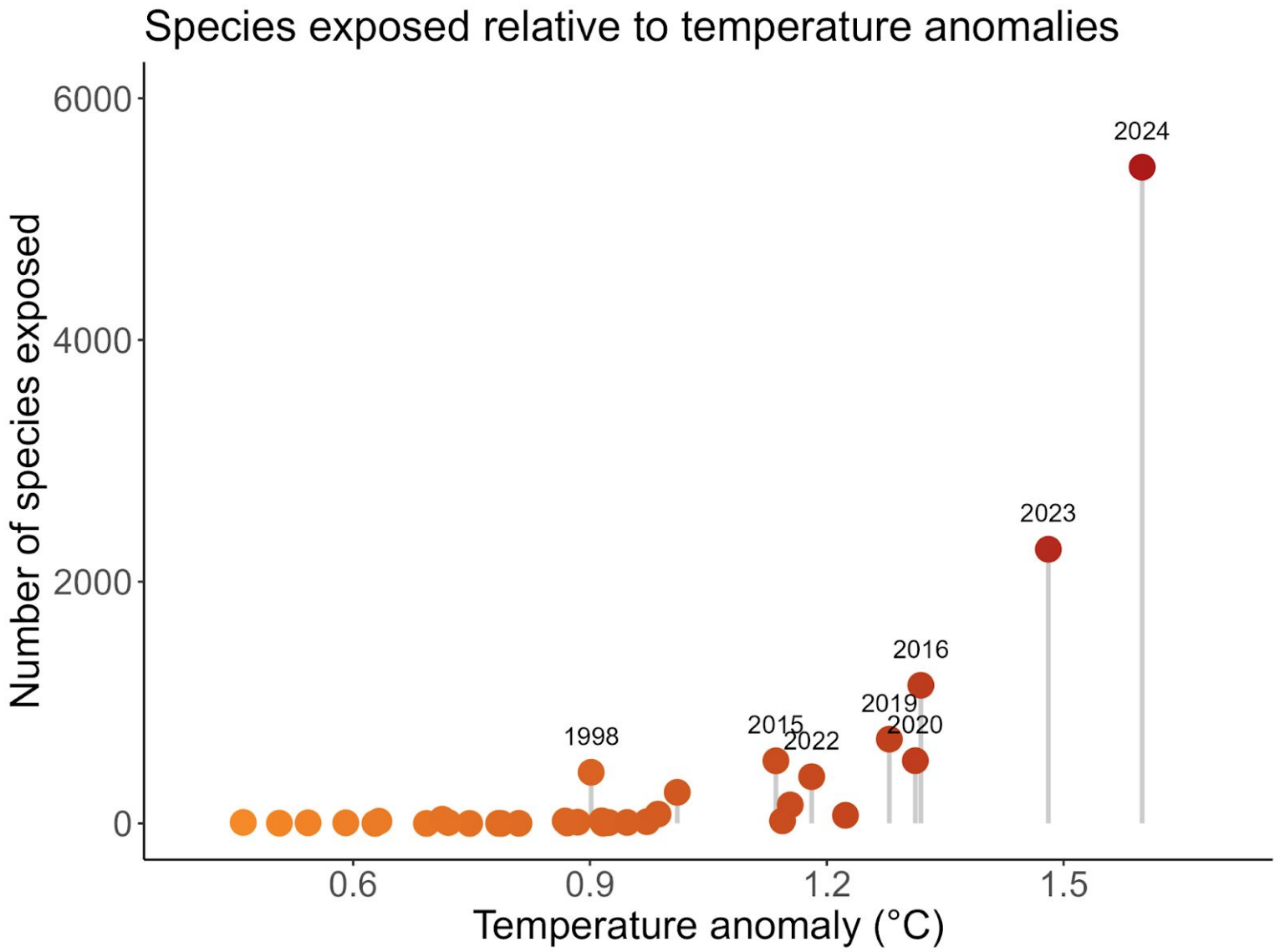
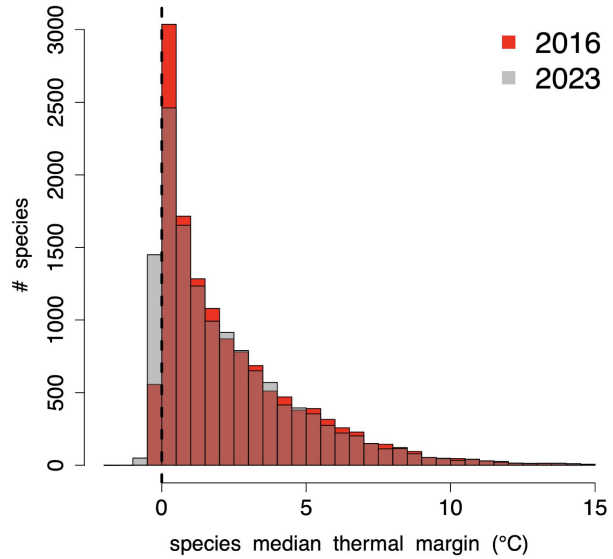
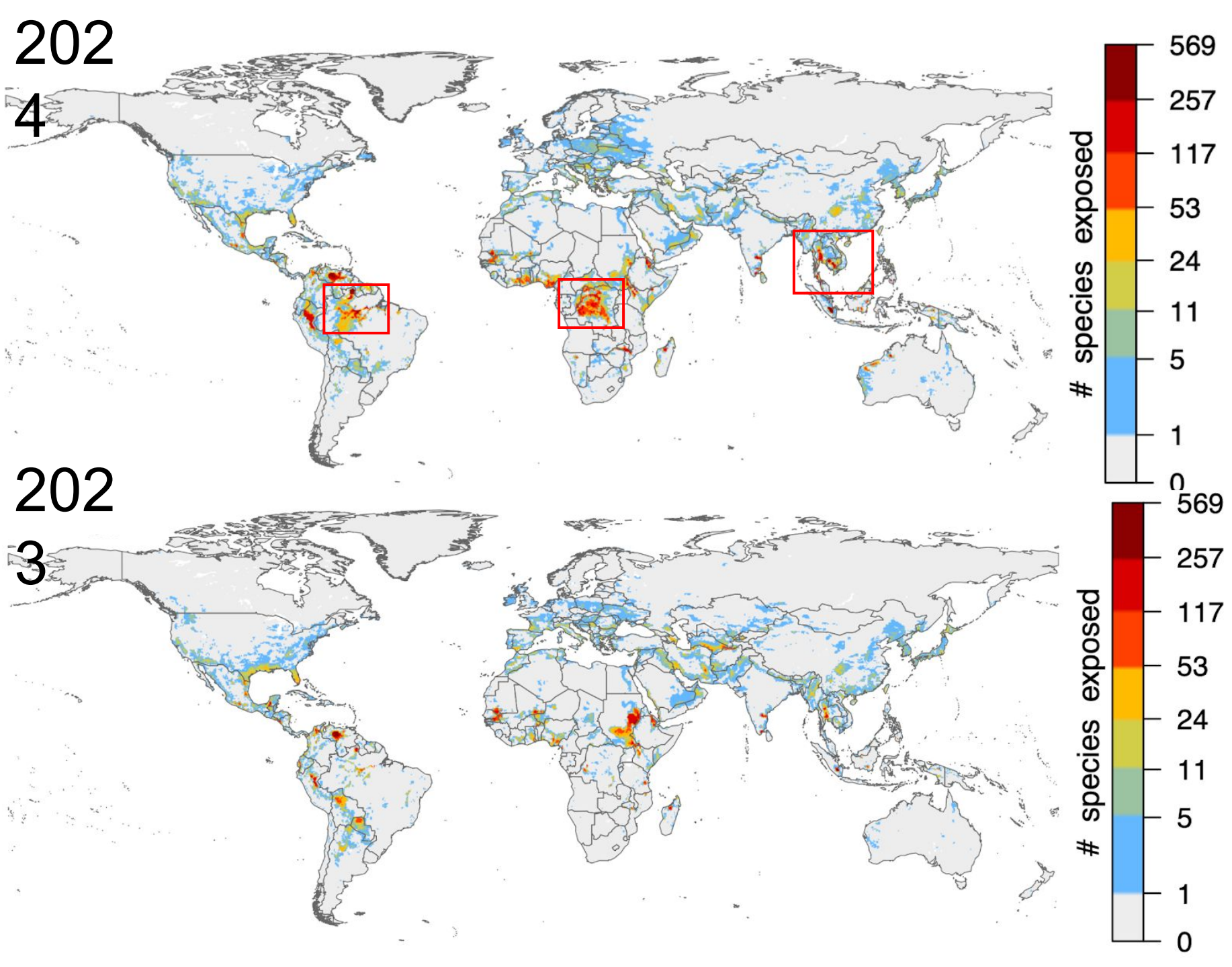
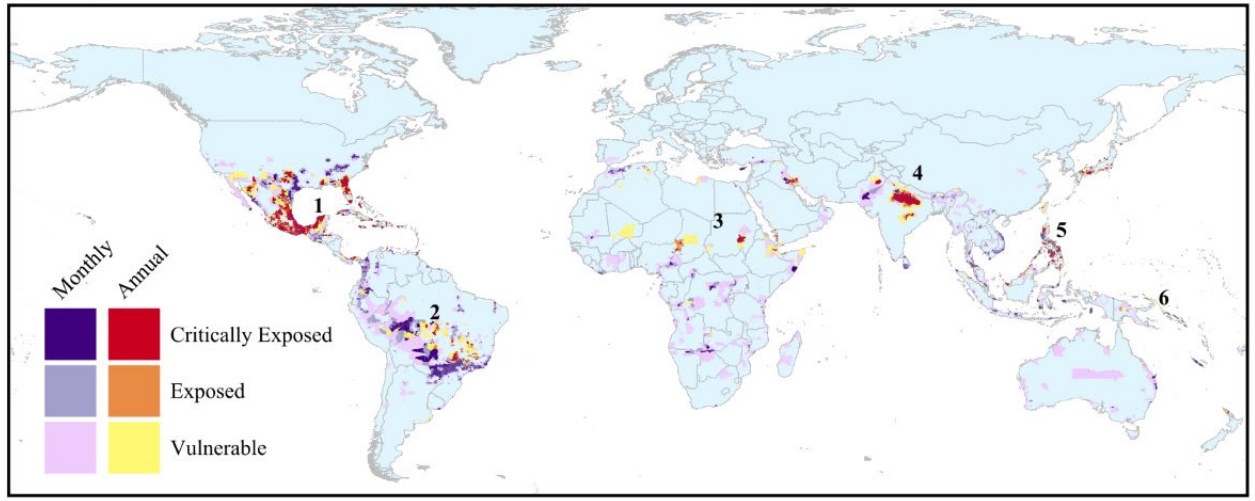




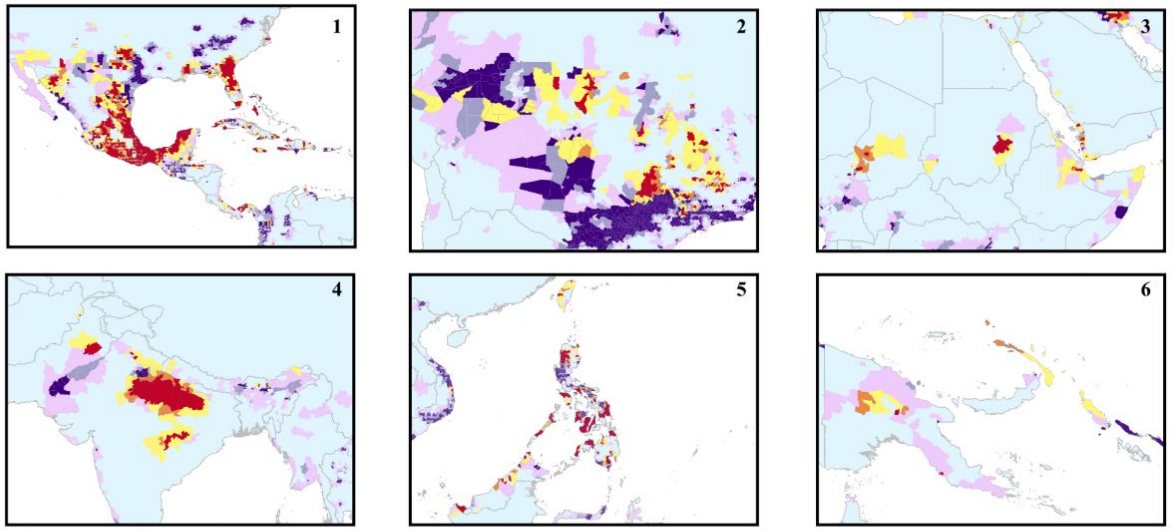

2024
2023
species exposed
569
257
117
53
24
11
5
1
0

Forecasting with NASA S2S – May 2024

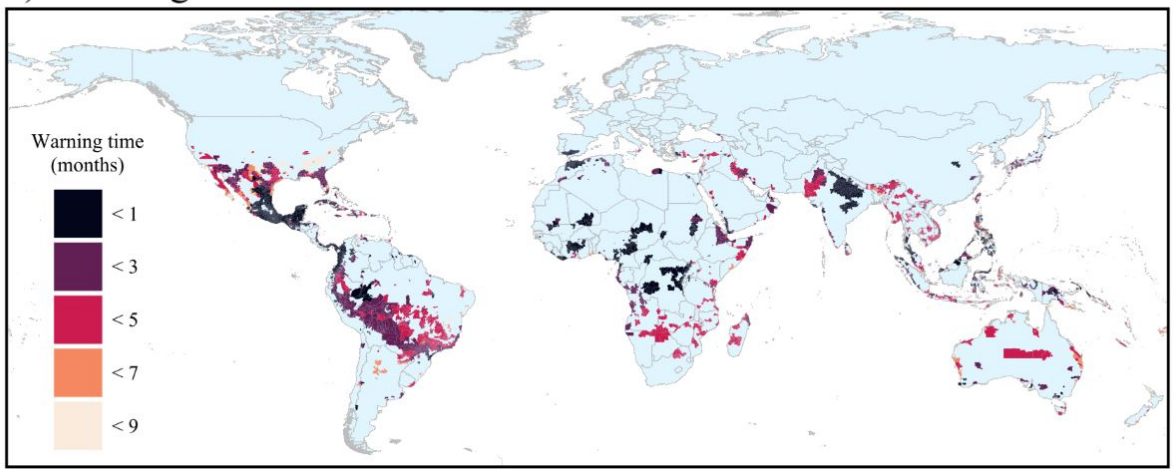
a) Exposure vulnerability classes in management units



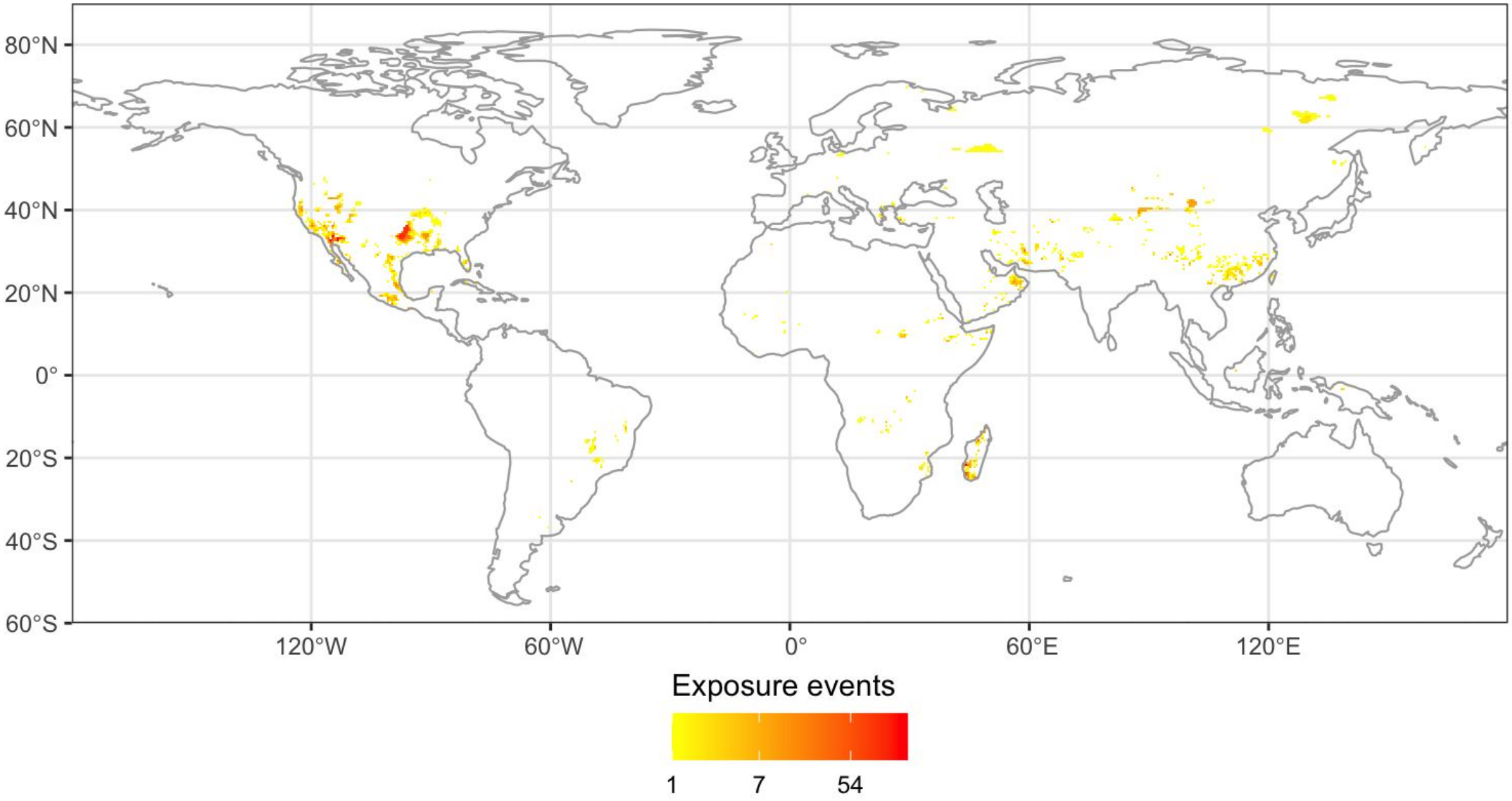
b) Regional exposure hotspots



c) Warning time



Forecasting the year ahead – April 2025



Thanks!

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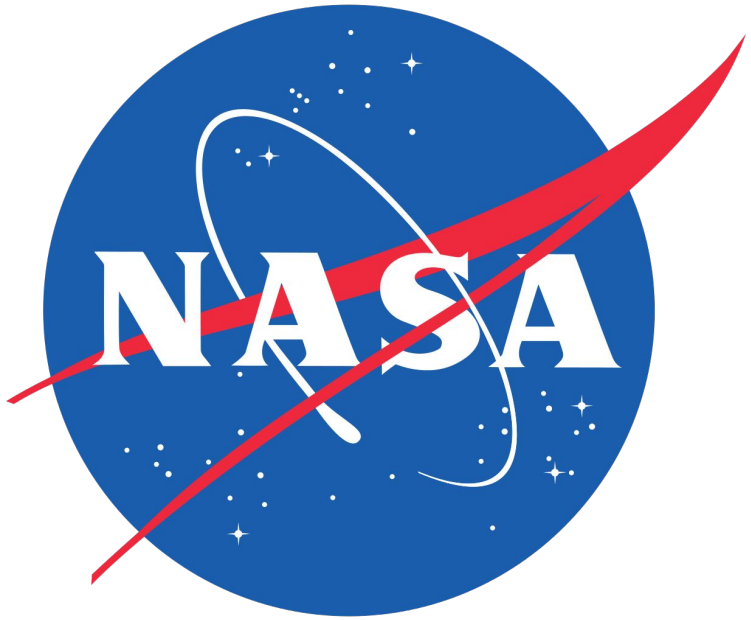
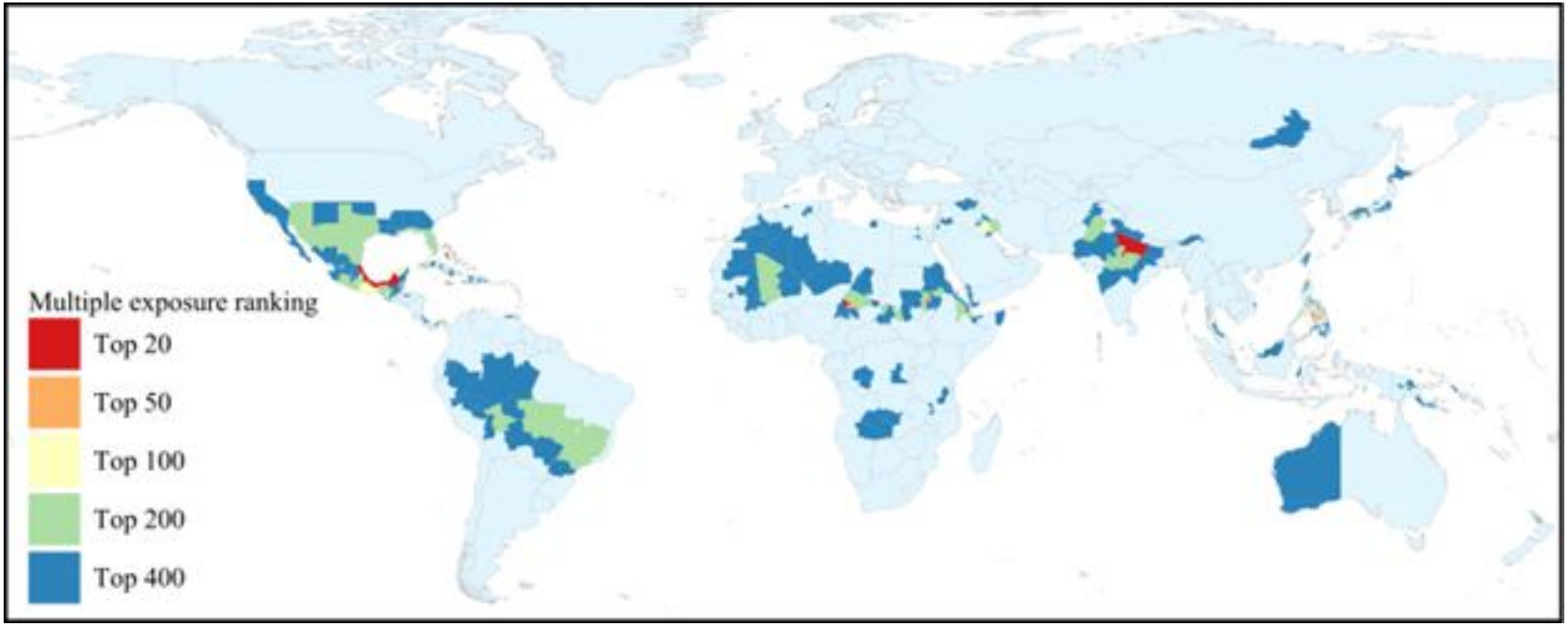
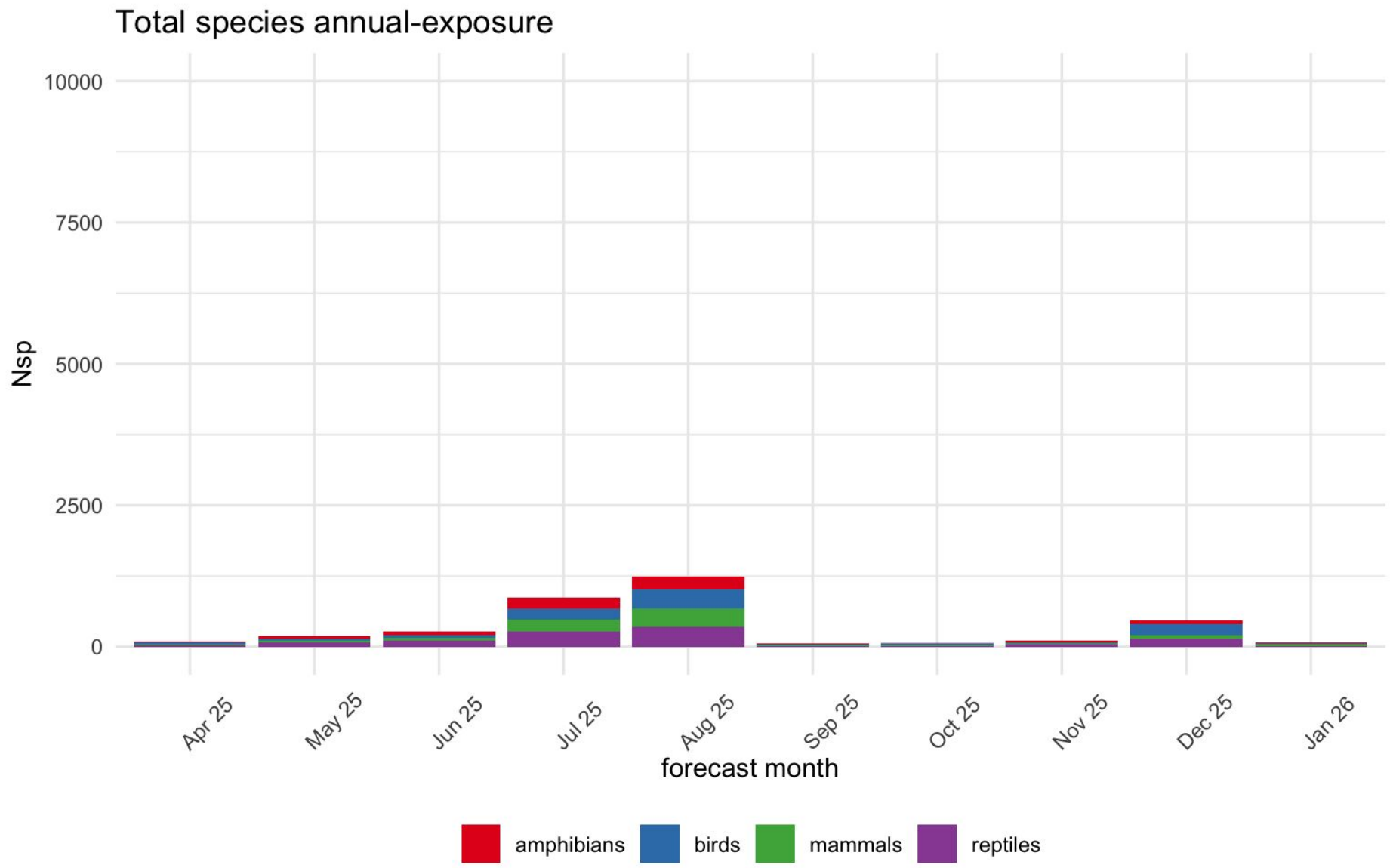
Questions?



Forecasting with NASA S2S – May 2024



April 2025 S2S Forecast



Conclusion

Zyrell et al, In review