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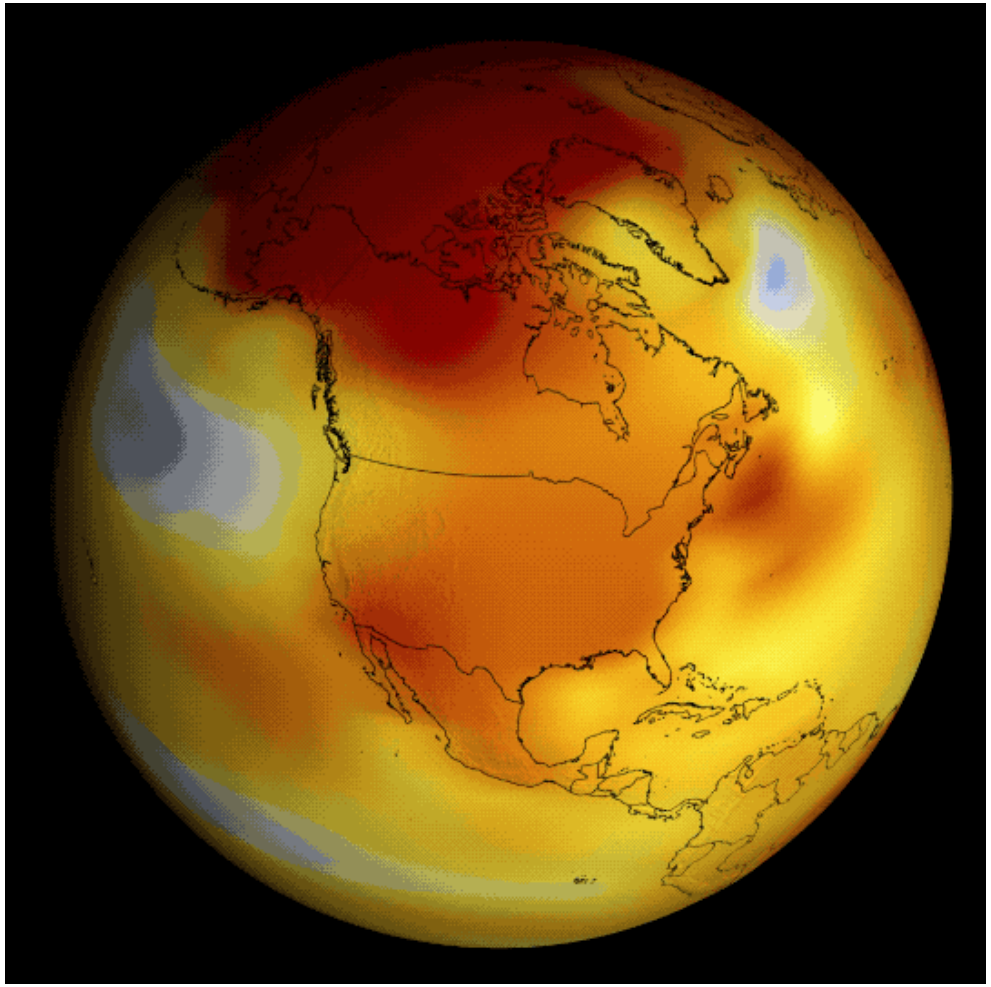
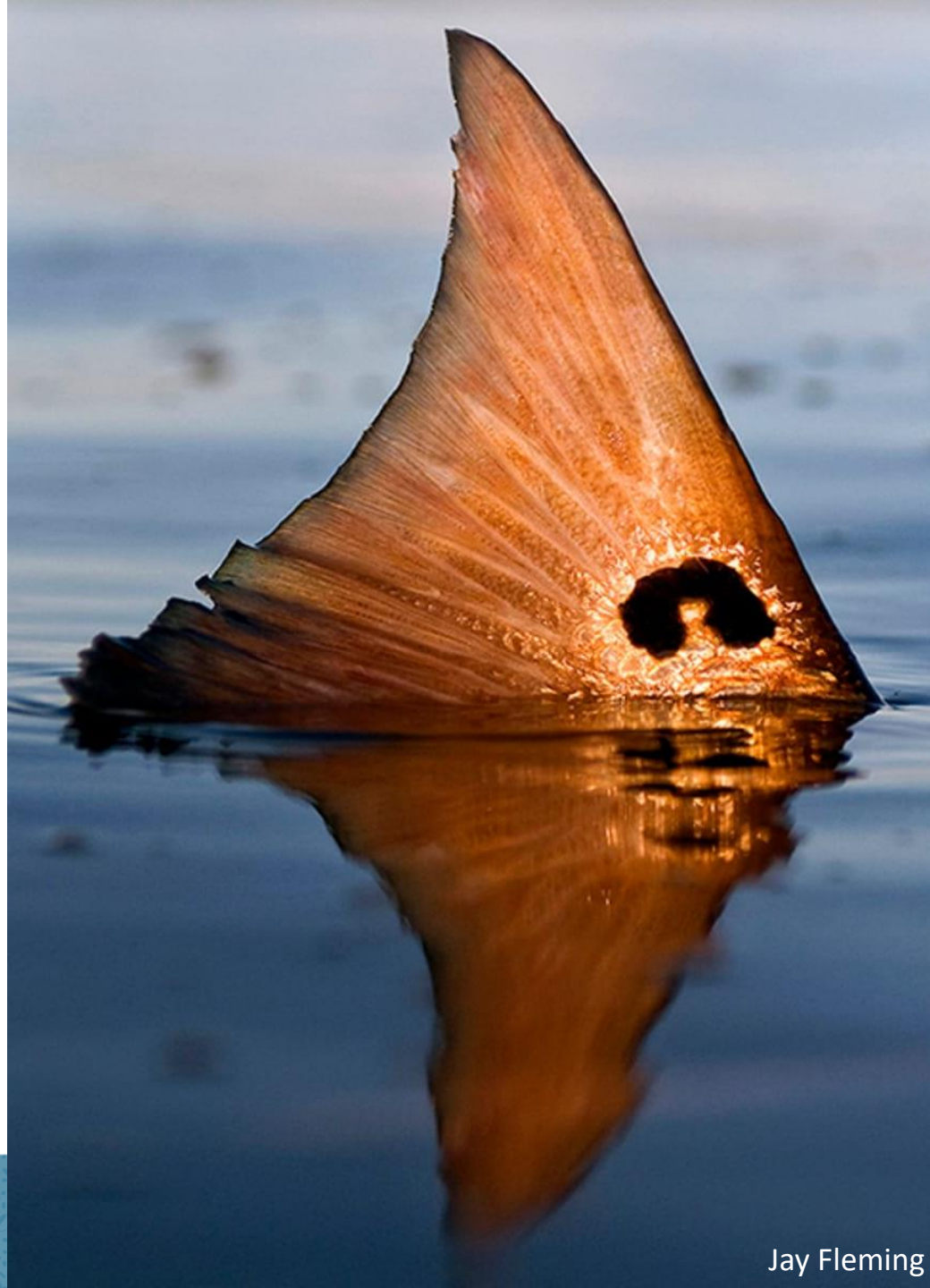
Postdoc
Rutgers University

Climate change impacts on fish physiology and fisheries ecology

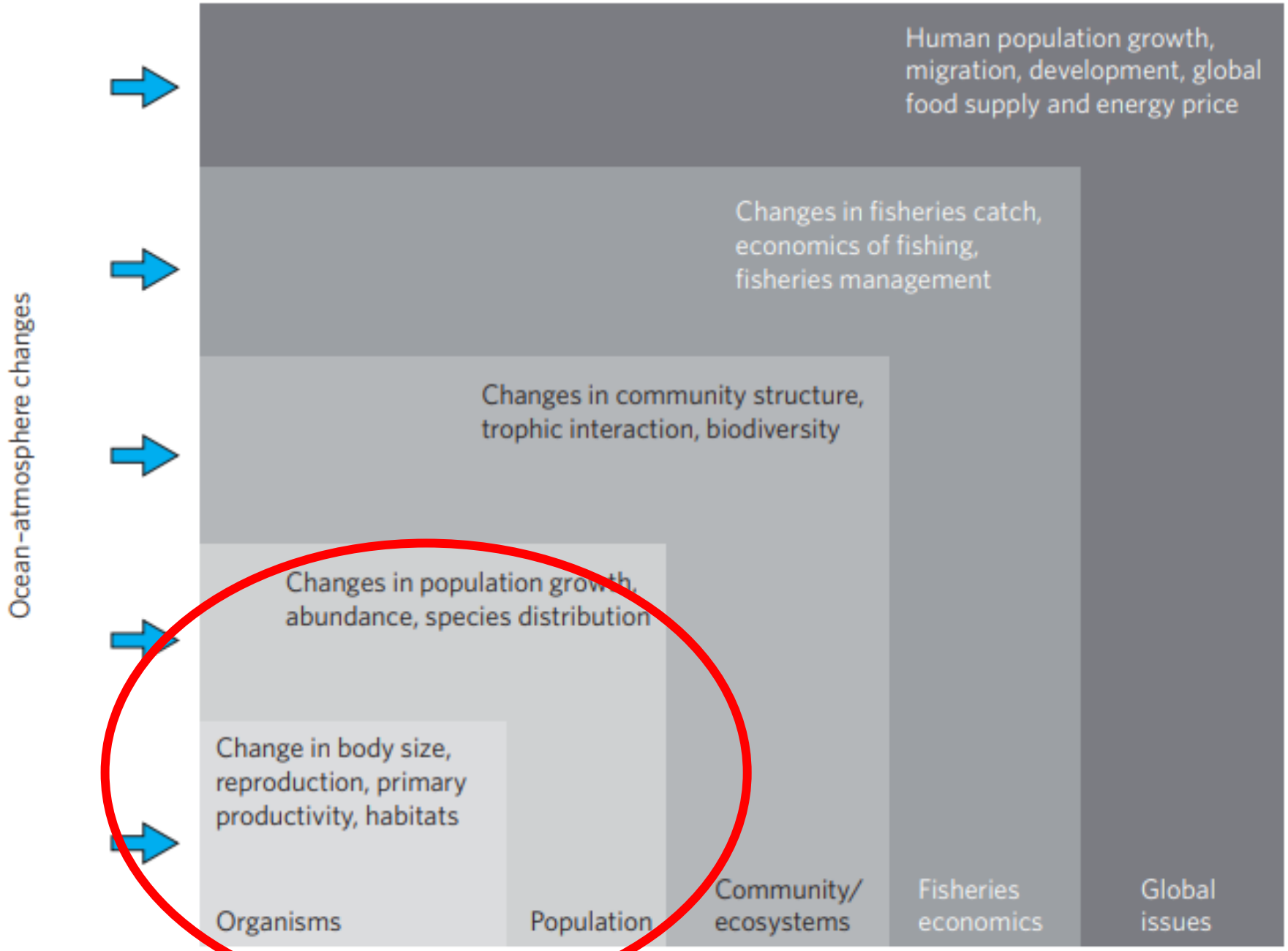
2022 SACNAS
The National Diversity in STEM Conference
October 27 - 29, 2022

How does warming affect fish?

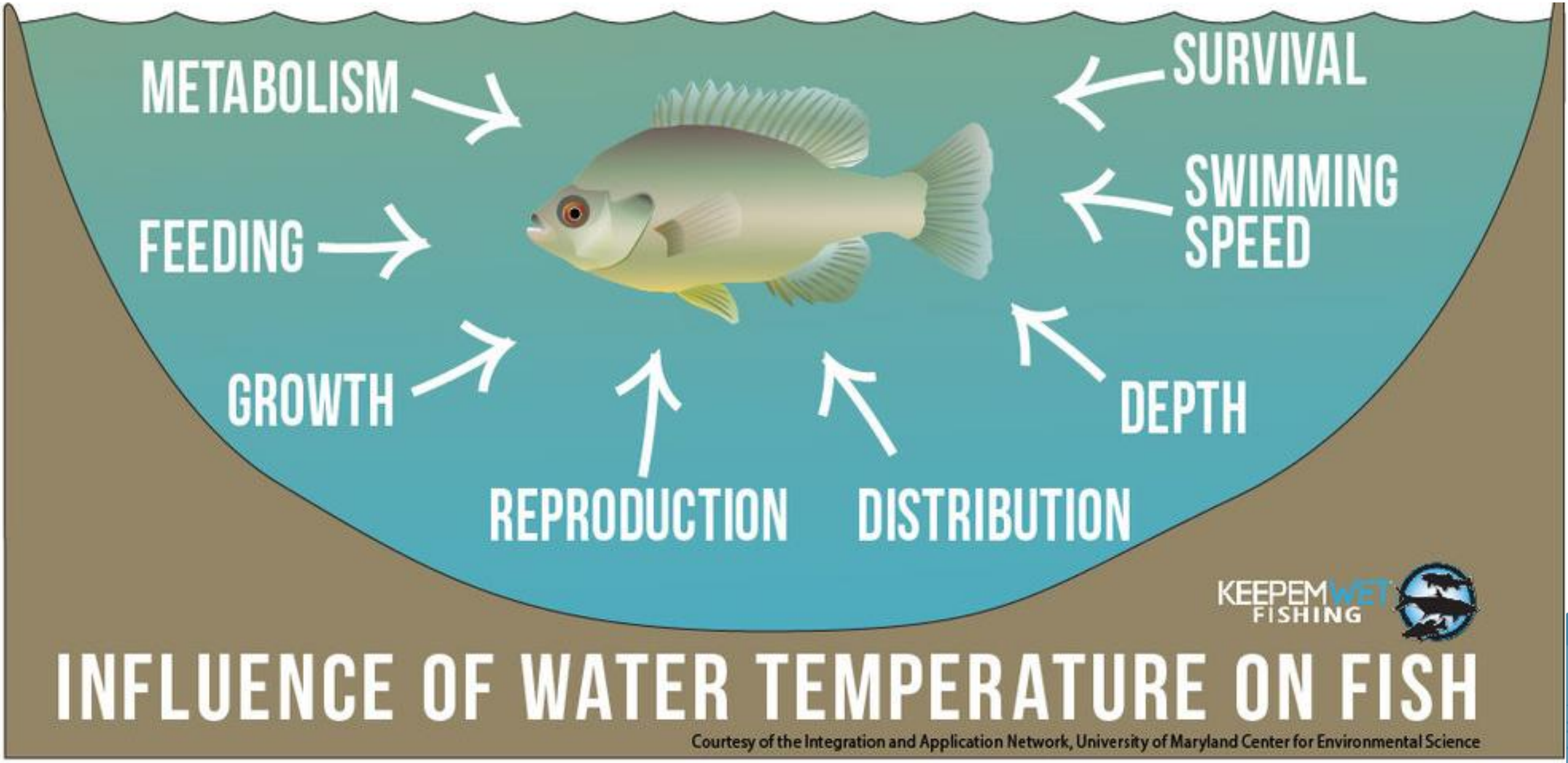




Jay Fleming



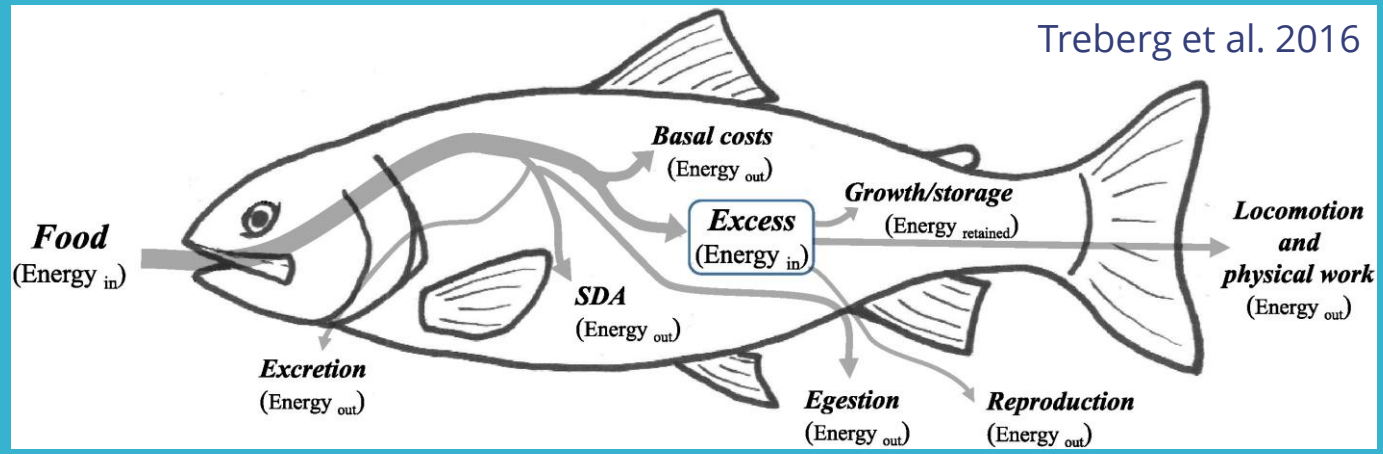
Sumaila et al. 2011

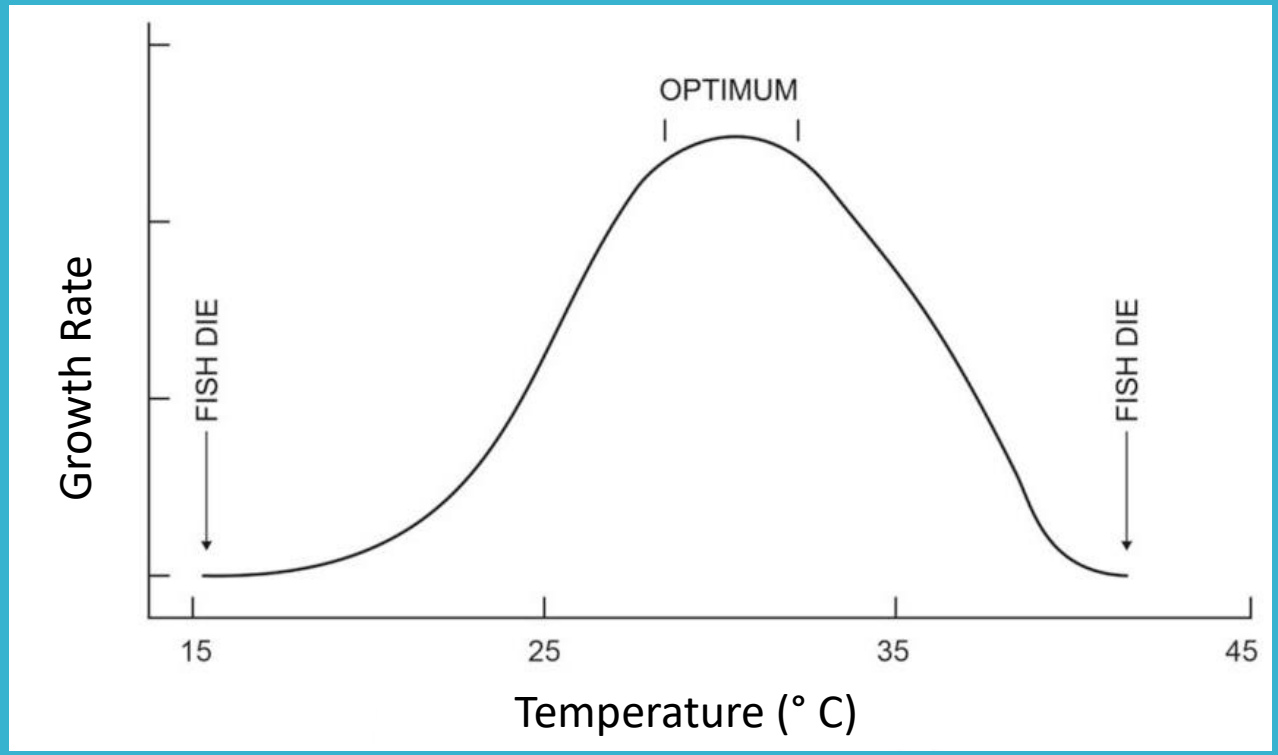

METABOLISM
FEEDING
GROWTH
REPRODUCTION
DISTRIBUTION
DEPTH
SWIMMING SPEED
SURVIVAL
KEEPEM WET FISHING
INFLUENCE OF WATER TEMPERATURE ON FISH
Courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science

Physiology

Metabolism

- Temperature speeds up reaction rate
- Higher temperatures can raise metabolic costs
- For some species this can lead to death

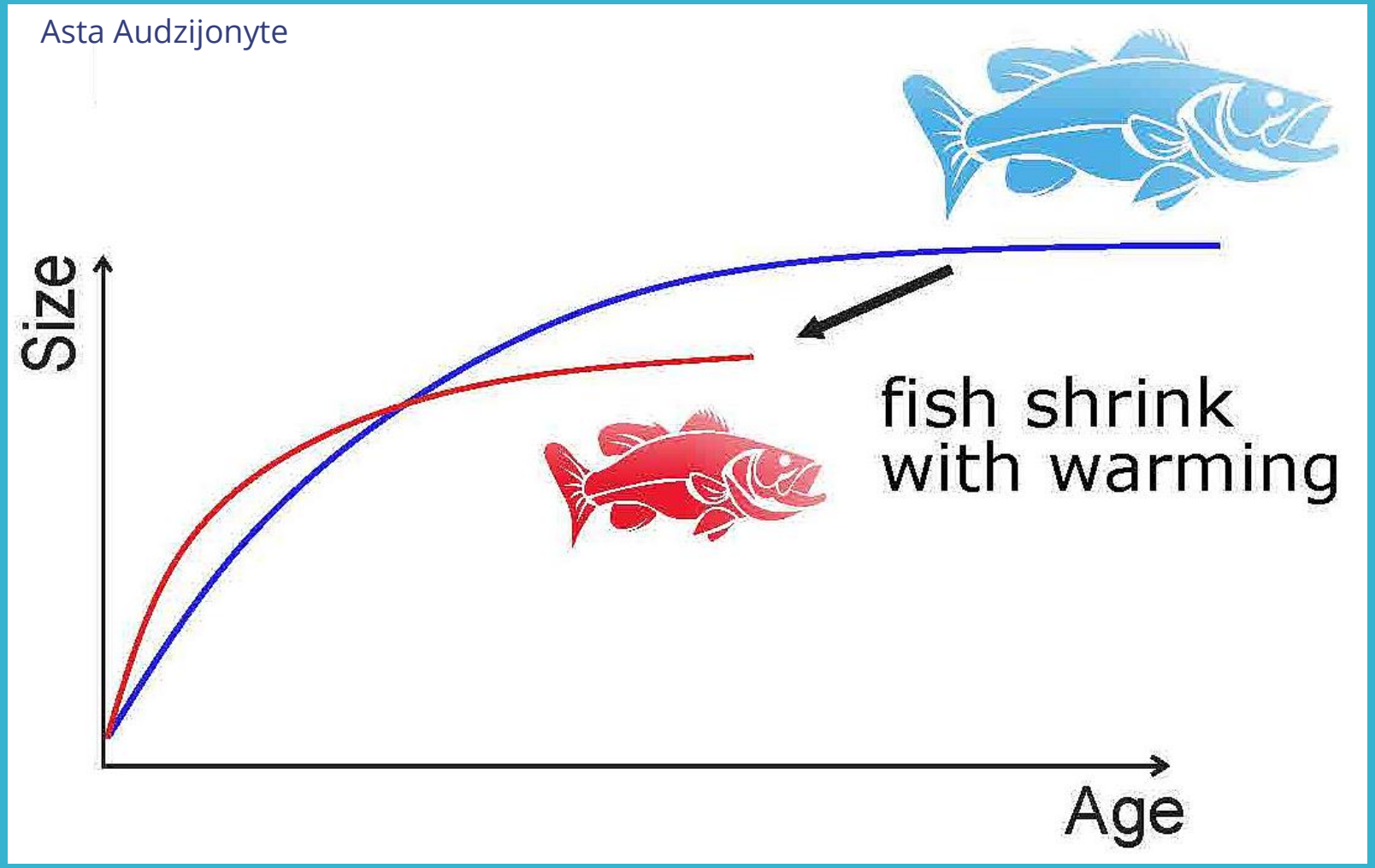


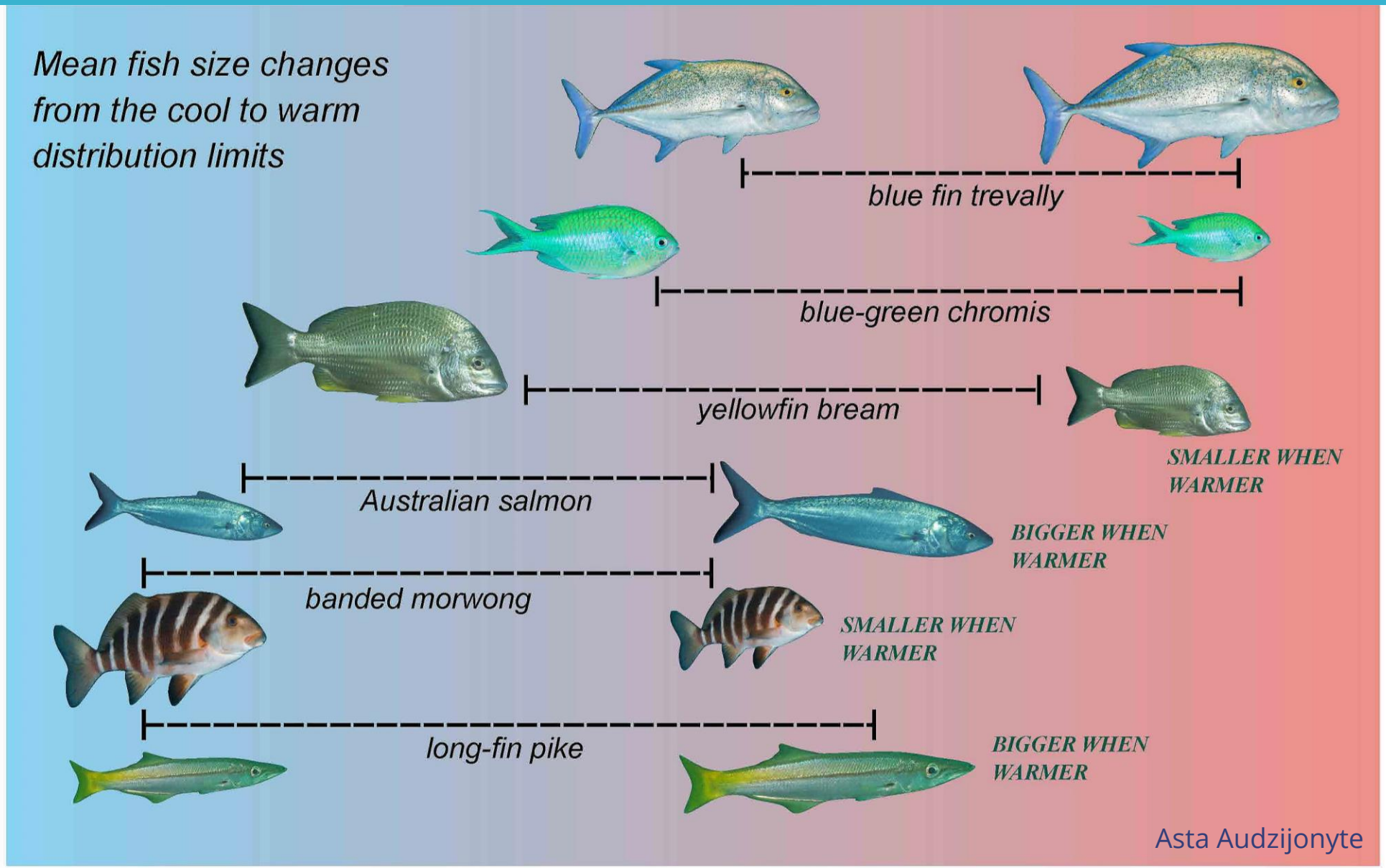


Physiology

Life History: Growth

Asta Audzijonyte





Temperate (~13C) — **Mean sea temperature** → Tropical (~29C)

Physiology

Life History: Survival

How can climate change affect survival?

Charles Poukish, MDE

Mahalie Stackpole

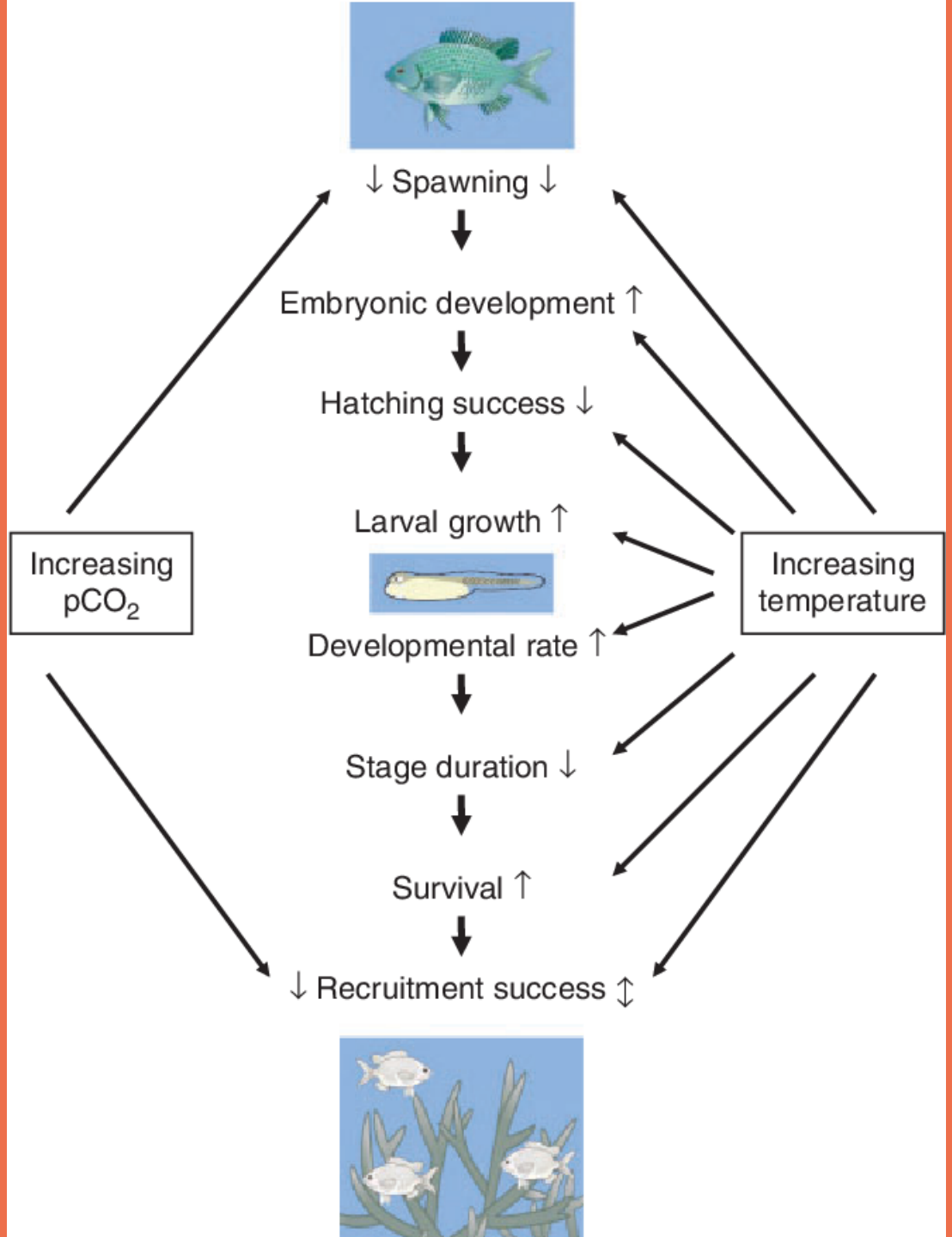
Tom Ardito, NBEP

Physiology

Life History: Reproduction

- Smaller fish are less fecund and produce less viable eggs
- Early life stage mortality is affected by
  - The environment
  - Timing and size at hatching
  - Developmental rate
  - Larval survival

Tony Wu

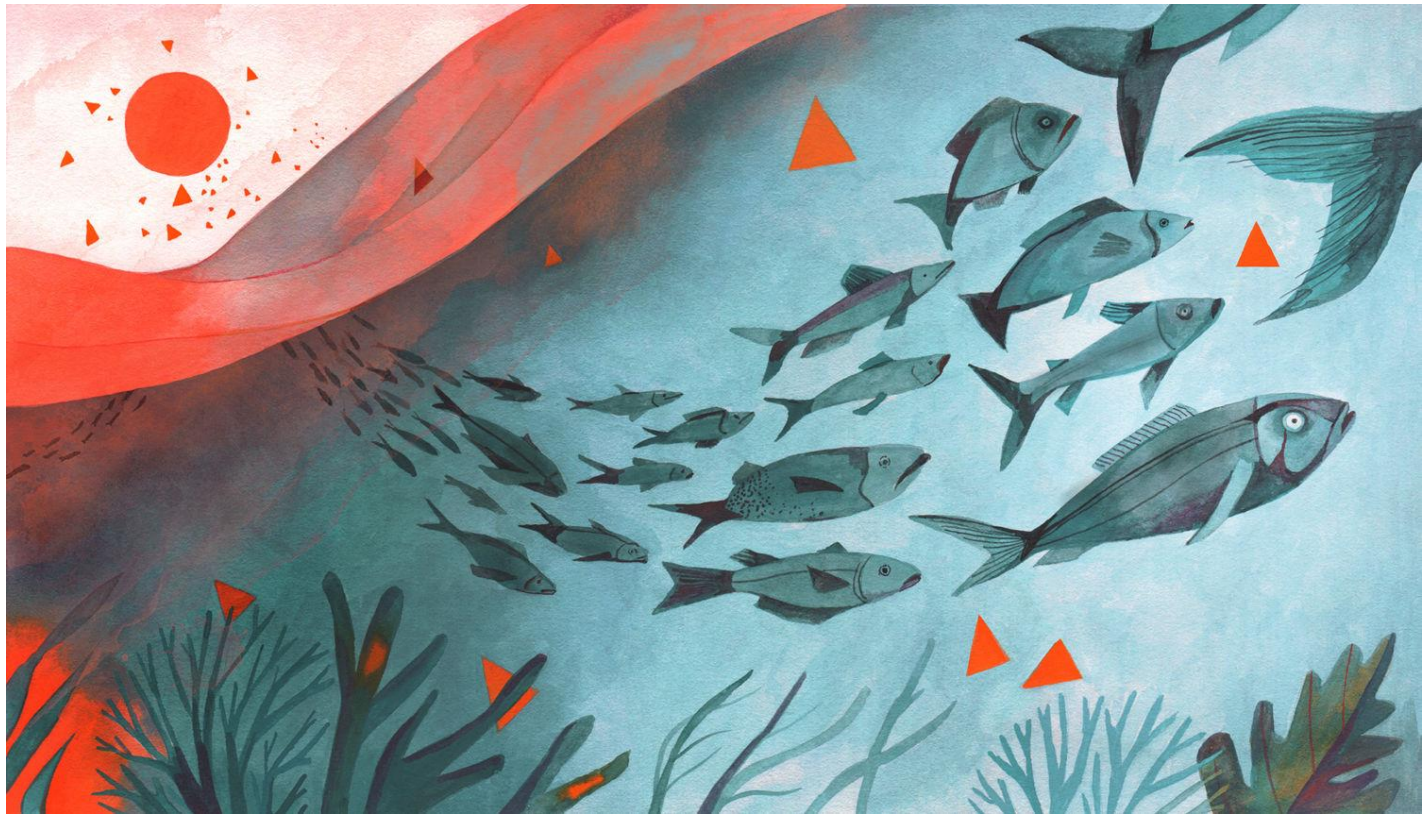


Pankhurst & Monday. 2011

Ecology

SPACE

- Latitudinal range defined by temperature tolerance
- As the environment changes, so does habitat suitability
- Distributions change



Fish are moving poleward and/or deeper

OCEAN WARMING

Poleward range expansion

Migrations farther north

Decreased spatial protections from commercial fishing

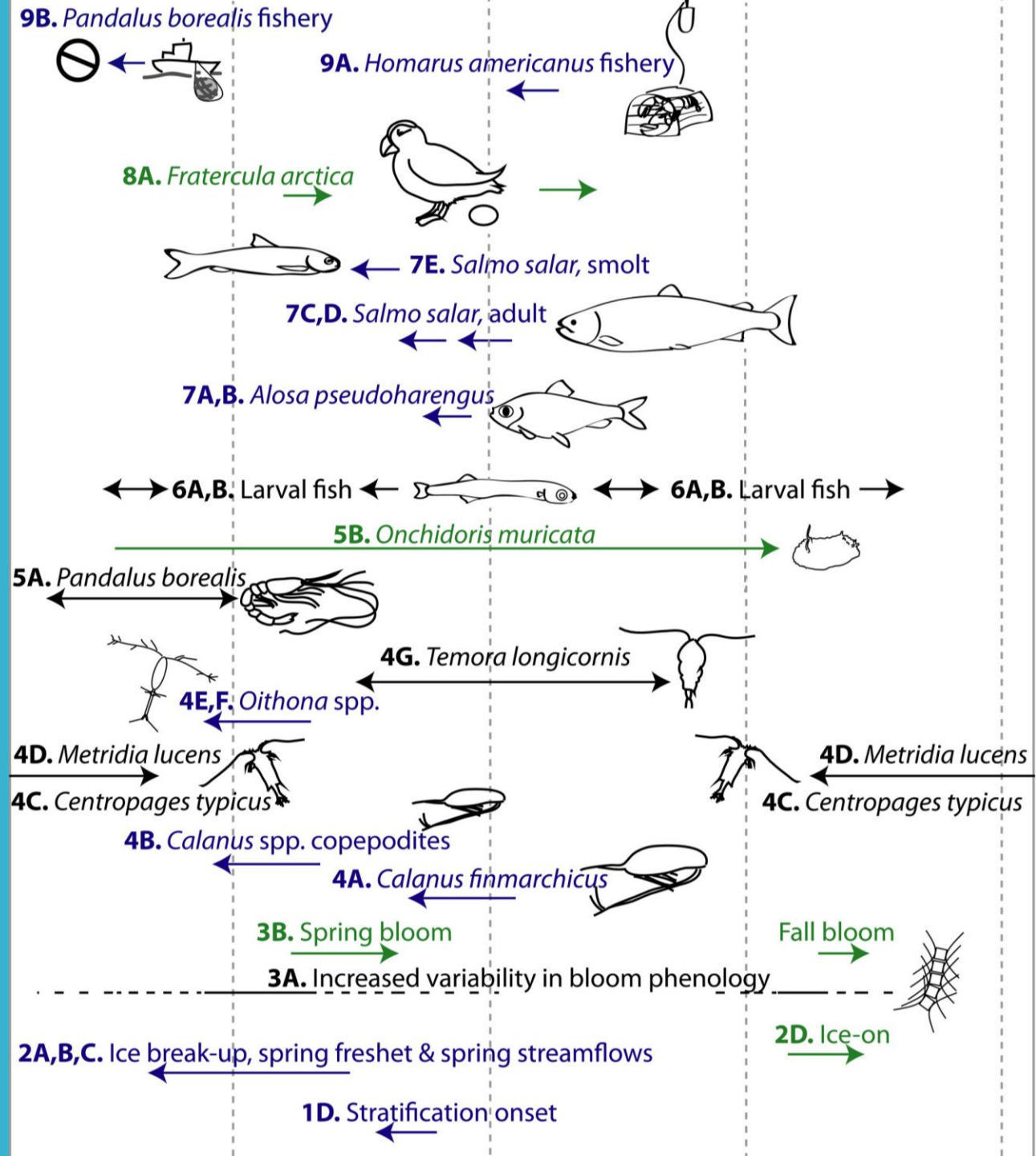
Earlier arrival times to northern regions

Hammerschlag et al. (2022). Ocean warming alters the distributional range, migratory timing, and spatial protections of an apex predator, the tiger shark (*Galeocerdo cuvier*). *Global Change Biology*

Ecology

TIME

- Key life history events are timed to environmental and ecological ques
- Many fisheries are also timed to those events
- As those cues change, it can create a mismatch between related processes
- For example, earlier hatching in warm leads to a partial mismatch between the availability of shrimp and the open fishing season



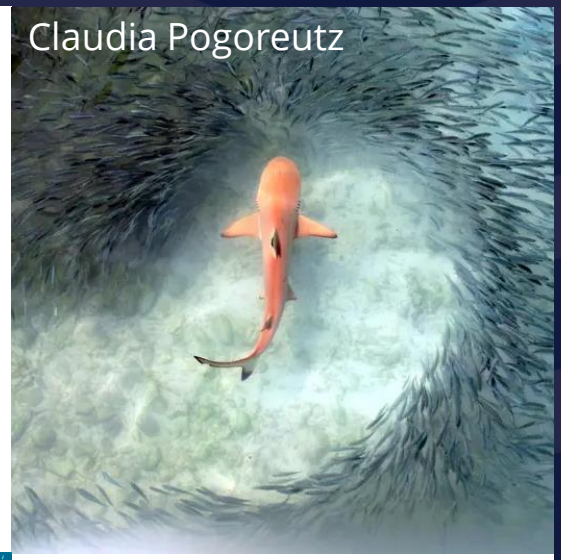
Staudinger et al. 2019

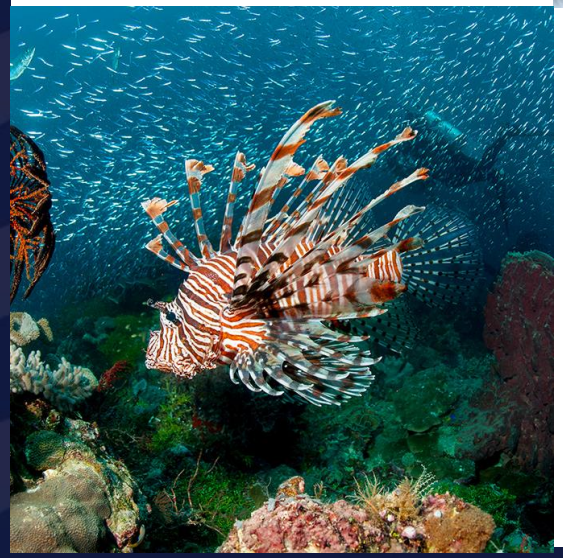
Ecology

SPECIES INTERACTIONS

As species are shuffled around, novel interactions arise

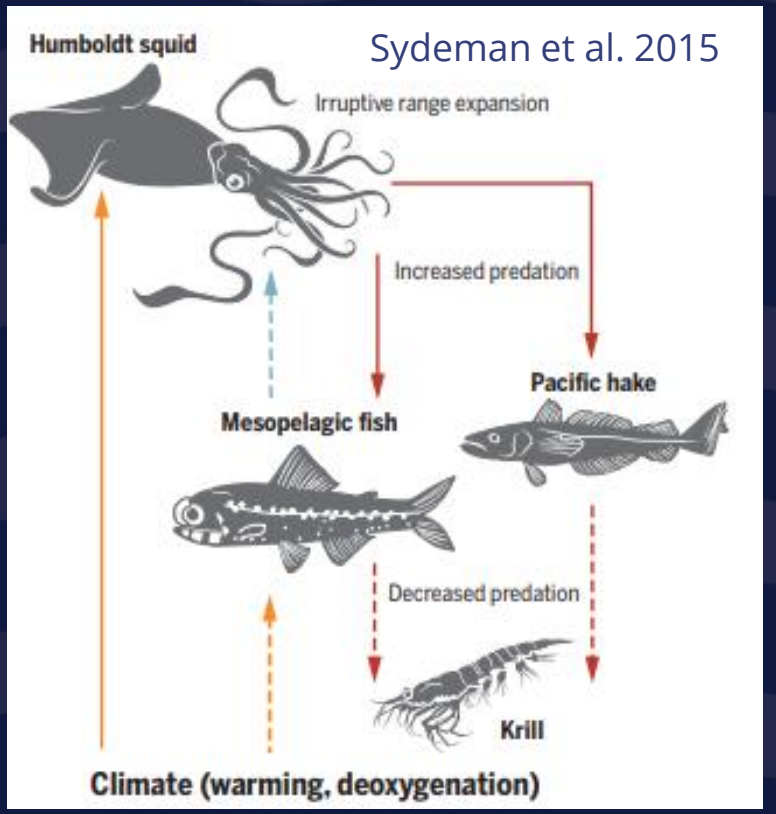
Competition





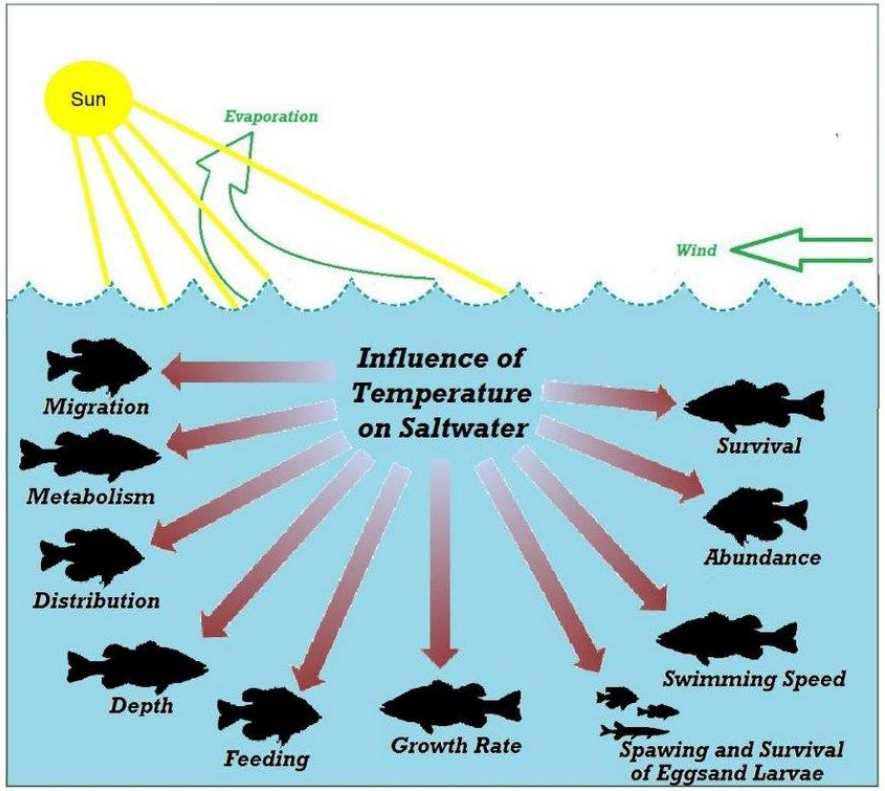
Alan Saben

Predation



Net impact of warming:

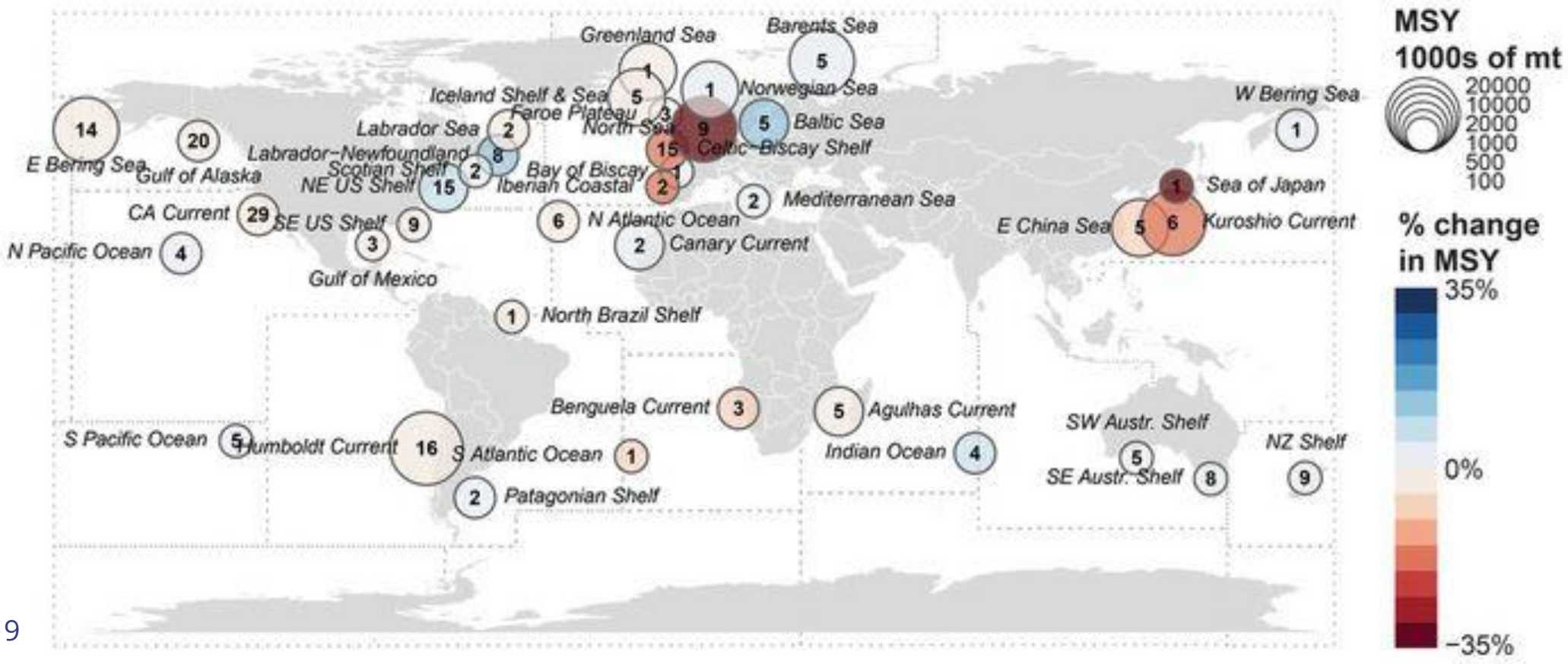
Some species benefit, others will be challenged



Depends on…

- Thermal Preference & Tolerance
- Acclimation Capacity
- Adaptability
- Life History Characteristics

TLDR



Free et al. 2019

- Some marine fish populations increase in size or in space occupied, others decline
- The net outcome for all populations in a region
  - Some regions have greater yields
  - Other regions have declining yields

References

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Thank you!
Questions?

The 2022 SACNAS National Diversity in STEM Conference

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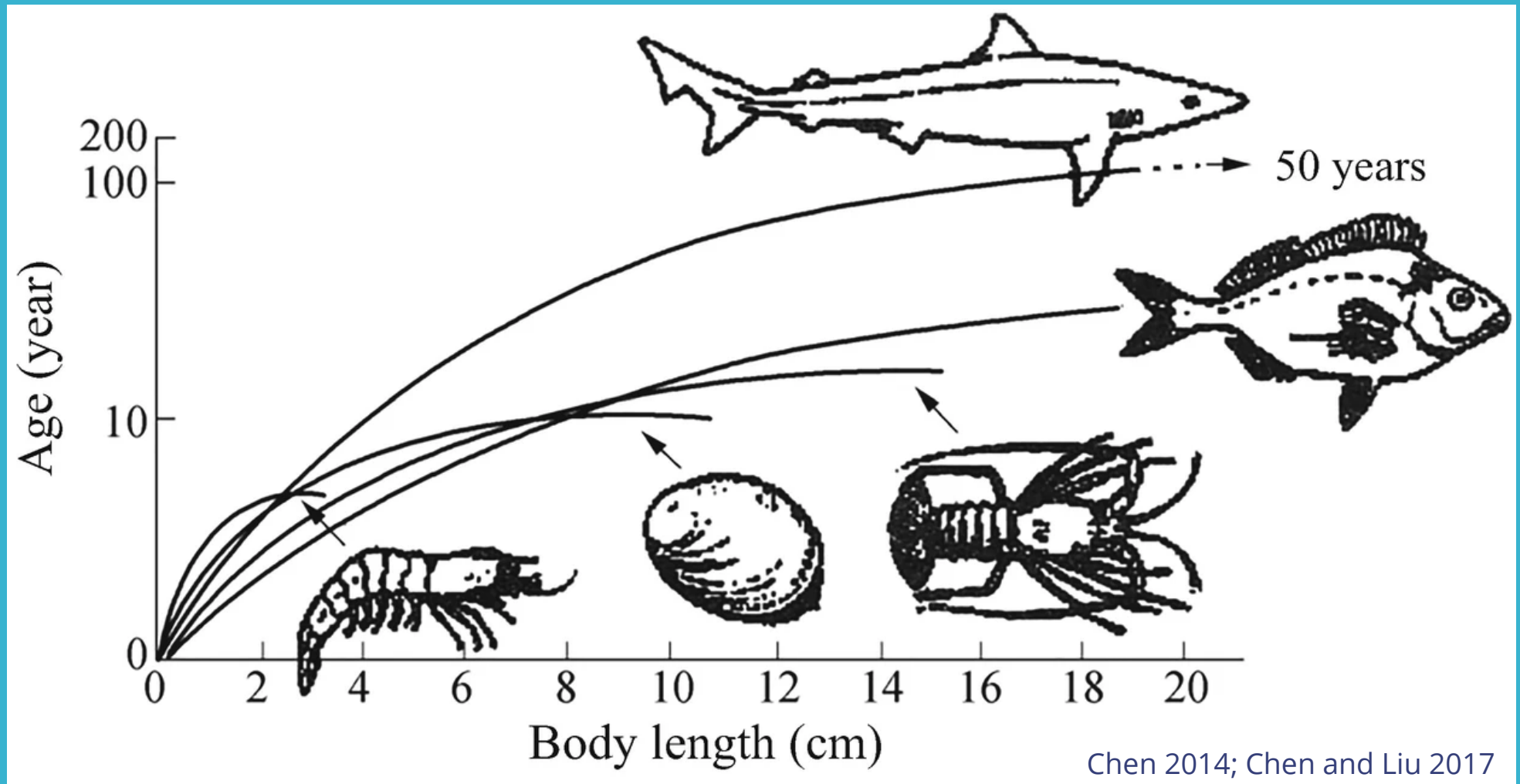
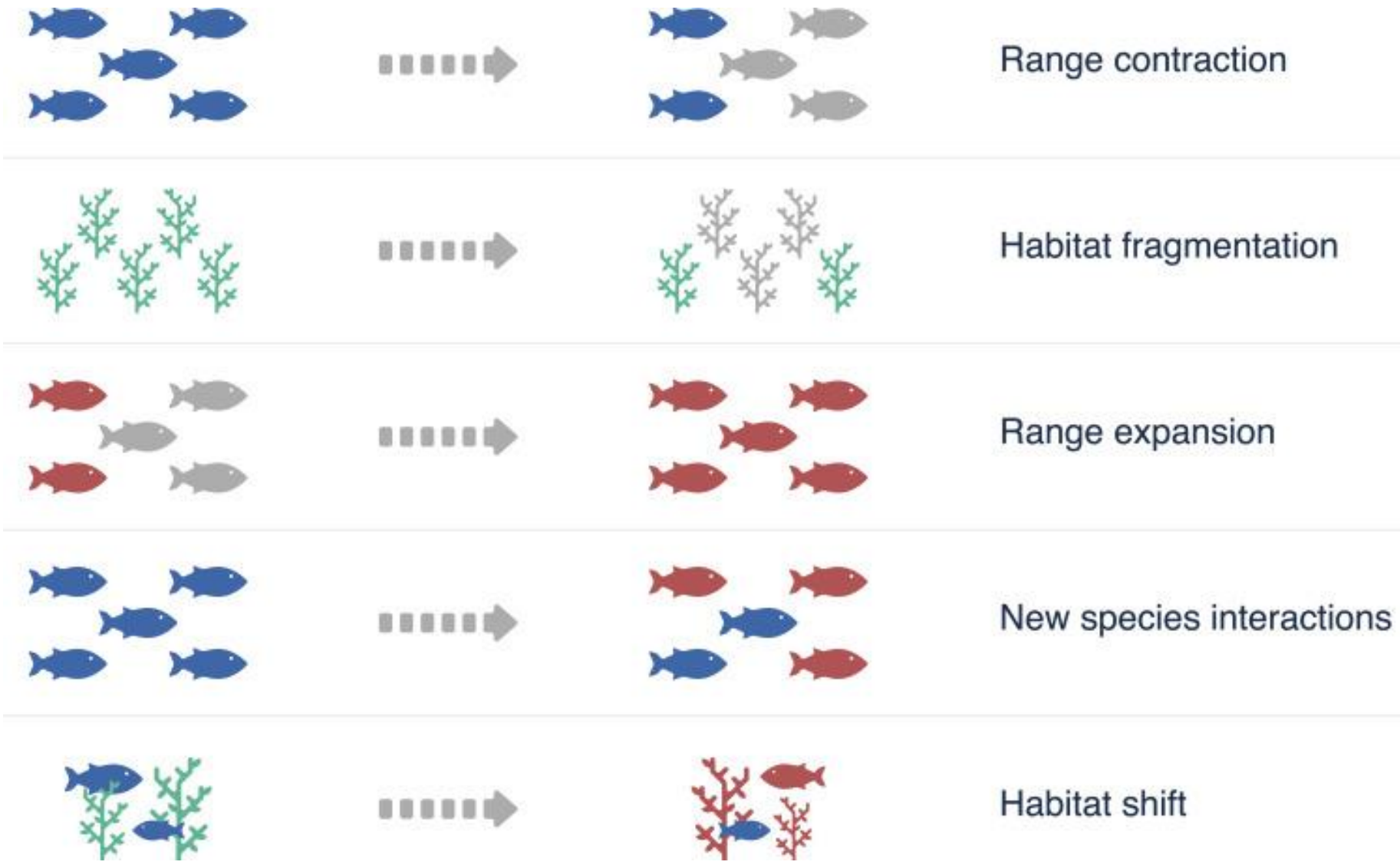
Physiology

Life History: Growth



Chen 2014; Chen and Liu 2017


Range contraction
Habitat fragmentation
Range expansion
New species interactions
Habitat shift