
Flat Creek


Pea River


Whitewater Creek

Updated surveys and status assessment of freshwater mussels in the Pea River Watershed

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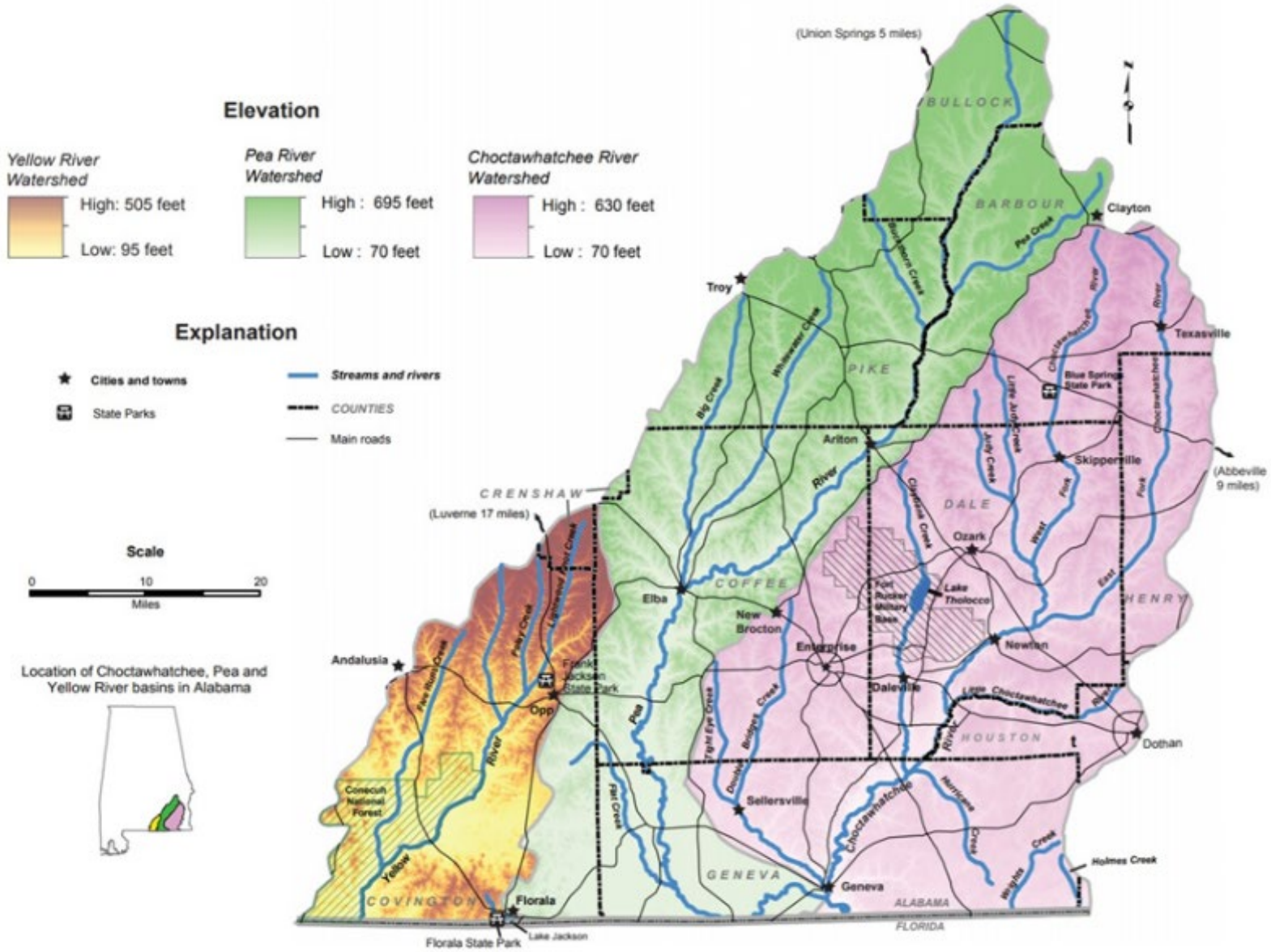
ALABAMA WILDLIFE & FRESHWATER FISHERIES

Freshwater Mussels of the Choctawhatchee/Pea River Watershed: Diversity and Status

- Choctawhatchee River Watershed
  - 24 species
  - 8 genera
- Pea River Watershed
  - 19 species
  - 16 genera
- *Ptychobranchus jonesi*
  - Federally-endangered
  - Surveyed 2005/2006*
  - Reassess occurrence/abundance

Subfamily	Species	Federal Status	State Status
Unioninae	***Pyganodon grandis* (Giant floater)**		
	***Strophitus williamsi* (Flatwoods creekshell)**		S2
	***Utterbackia imbecillis* (Paper pondshell)**		
	***Utterbackia peggyae* (Florida floater)**		S1
Ambleminae	*Amblema plicata* (Threeridge)		
	Glebula rotundata (Round pearlshell)		S2
	***Hamiota australis* (Southern sandshell)**	T	S2
	***Lampsilis floridensis* (Florida sandshell)**		S2
	***Lampsilis straminea* (Southern fatmucket)**		
	***Leaunio lienosus* (Little spectacle case)**		
	Medionidus acutissimus (Alabama moccasinshell)	T	S2
	***Obovaria choctawensis* (Choctaw bean)**	E	S2
	Obovaria haddletoni (Hadleton lampmussel) *		
	***Ptychobranchus jonesi* (Southern kidneyshell)**	E	S1
	***Toxolasma sp.* (Gulf lilliput)**		S1
	***Villosa vibex* (Southern rainbow)**		
	Villosa villosa (Downy rainbow)		S1
	***Elliptio arctata* (Delicate spike)**	UR	S2
	***Elliptio mcmichaeli* (Fluted elephantear)**		S2
	***Elliptio pullata* (Gulf spike)**		
	***Fusconaia burkei* (Tapered pigtoe)**	T	S2
	***Pleurobema strodeanum* (Fuzzy pigtoe)**	T	S2
	***Cyclonaias succissa* (Purple pigtoe)**		S3
	***Uniomerus tetralamus* (Pondhorn)**		

*Gangloff and Hartfield, 2009



Objectives

- Sample up to 30 sites
- Status: *Ptychobranchus jonesi* and other federally/state-listed species
- Analyze relationships between *P. jonesi* presence and...
  - Habitat quality
  - Water quality
  - Land use
- Investigate variation in thermal tolerance among common species

Approach

- Survey reach (up to 300 m) by 30 m transects
- Search all available habitat
  - Search targeted habitat
- Gather habitat and water quality data
- Respirometry experiments and behavior observations under thermal stress

STATUS SURVEYS

Survey results

28 sites completed

15 species: 0 - 10 per site: μ = 6

7,538 live individuals: 0 - 1,246 per site: μ = 269

Abundance

1) *Elliptio pullata*
2) *E. mcmichaeli*
3) *Leaunio lienosus*
4) *Lampsilis straminea*
5) *Pleurobema strodeanum*
6) *Hamiota australis*
7) *Uniomerus tetralasmus*
8) *Villosa vibex*
9) *Cyclonaias succissa*
10) *Ptychobranchus jonesi*
11) *Fusconaia burkei*
12) *Lampsilis floridensis*
13) *Strophitus williamsi*
14) *Toxolasma sp.*
15) *Obovaria choctawensis*

Threated/Endangered (# individuals; # sites)

P. jonesi (90; 7)

F. burkei (41; 15)

H. australis (240; 16)

O. choctawensis (3; 3)

P. strodeanum (524; 15)

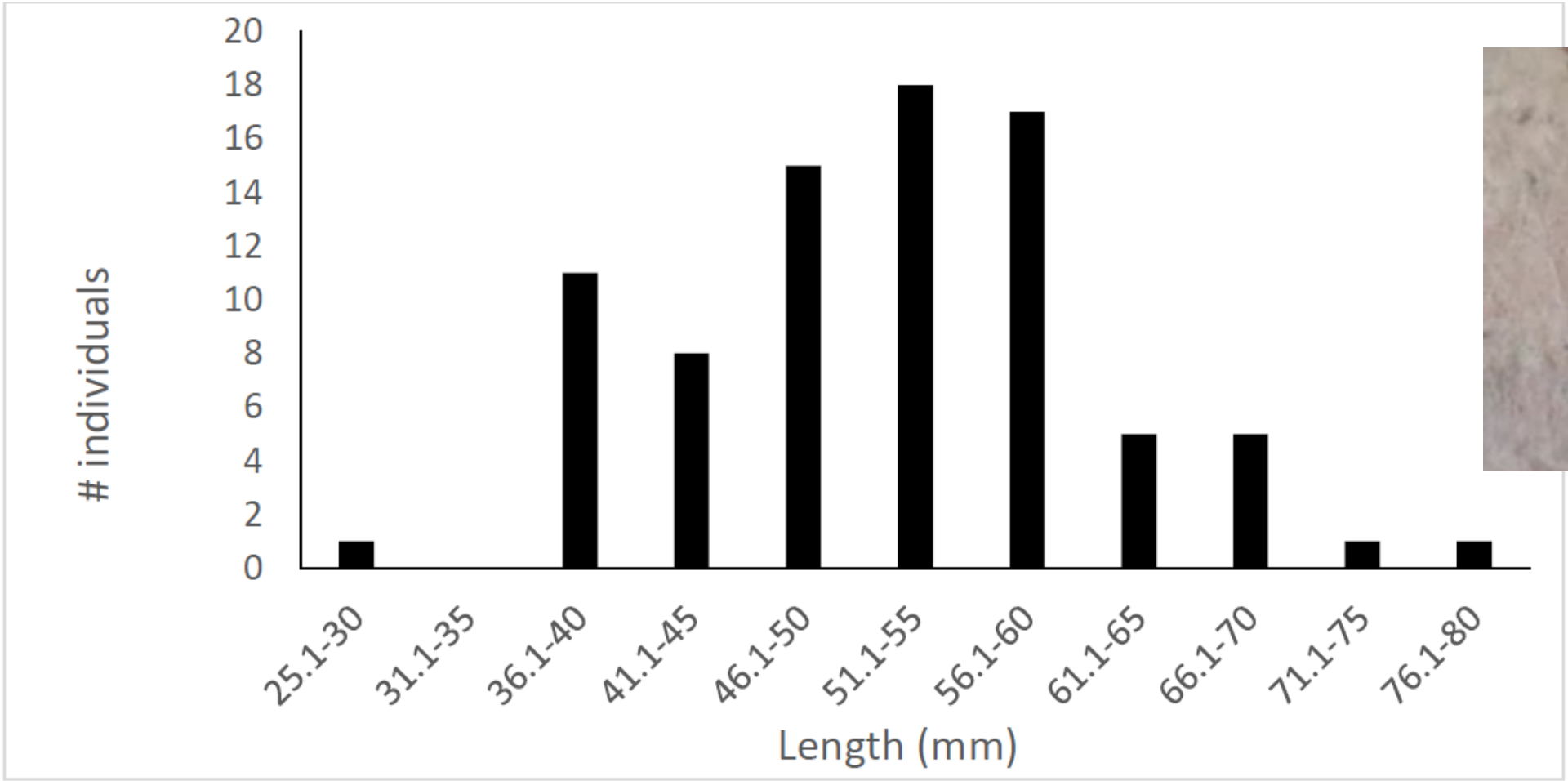


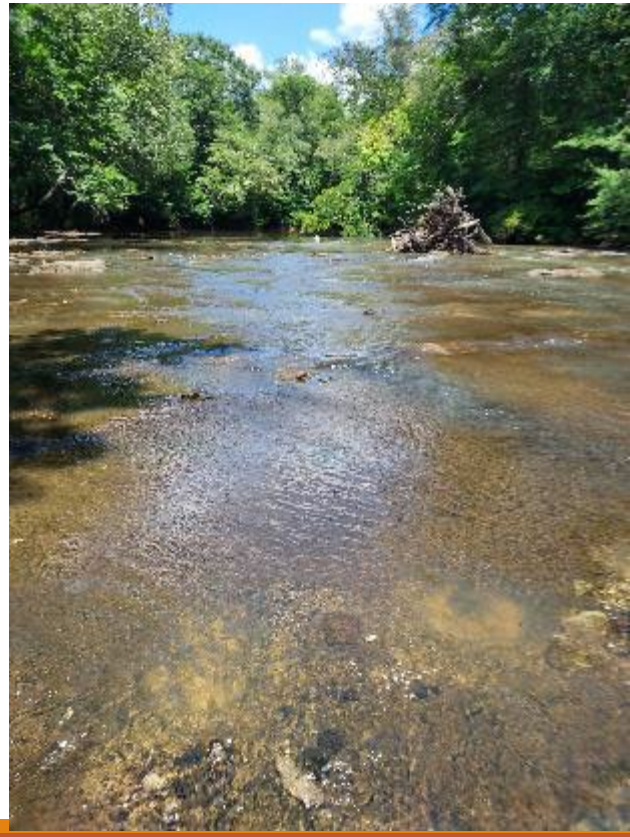
Figure 3. Size distribution of *Ptychobranchus jonesi* at all sites combined. A total of 90 live individuals were observed and measured.

Multiple regression models

Available predictors included physicochemical, water quality, and habitat variables

Response	Best Model	Partial Correlations	R^2	p
Total Catch	Hardness	-0.607	0.345	0.003
	NO3	0.43		
CPUE	Hardness	-0.653	0.442	0.001
	NO3	0.41		
Richness	Hardness	-0.469	0.22	0.016
P. jonesi	PO4	0.455	0.207	0.02
H. australis	PO4	0.49	0.24	0.011
P. strodeanum	none			

Typical habitat reaches



Critical habitat reaches

EPA-RBP habitat scores: 94.5 – 173.5

Freshwater Mussels of the Pea River Watershed: Diversity and Status

- Native assemblages persist
- Two federally-listed spp. were found at multiple sites
  - *P. strodeanum* and *H. australis*
- Two federally-listed spp. continue to be uncommon
  - *O. choctawensis* and *F. burkei*
- Relatively frequent occurrence of *P. jonesi*
  - Confined to mainstem
  - Confirmed persistence at historical sites (Gangloff and Hartfield 2009)
  - 3 sites with higher abundances, spanning considerable size range
- Geomorphically stable habitat is critical
  - Bedrock outcrops, pocketed hardpan, limestone cracks, etc.
  - Harbor many listed species
  - Often unavailable due to heavy sedimentation and embeddedness

Species-specific thermal stress responses in freshwater mussels of the Pea River

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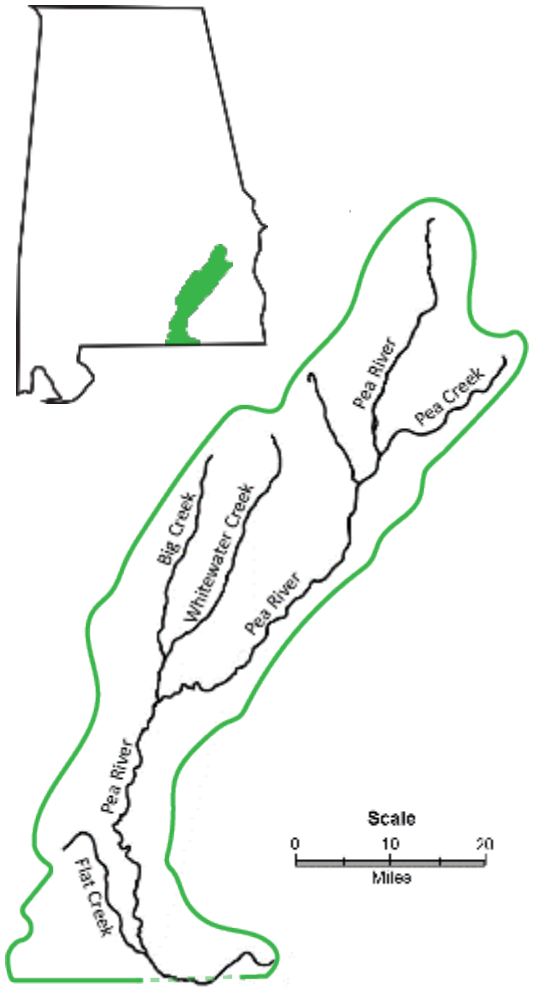
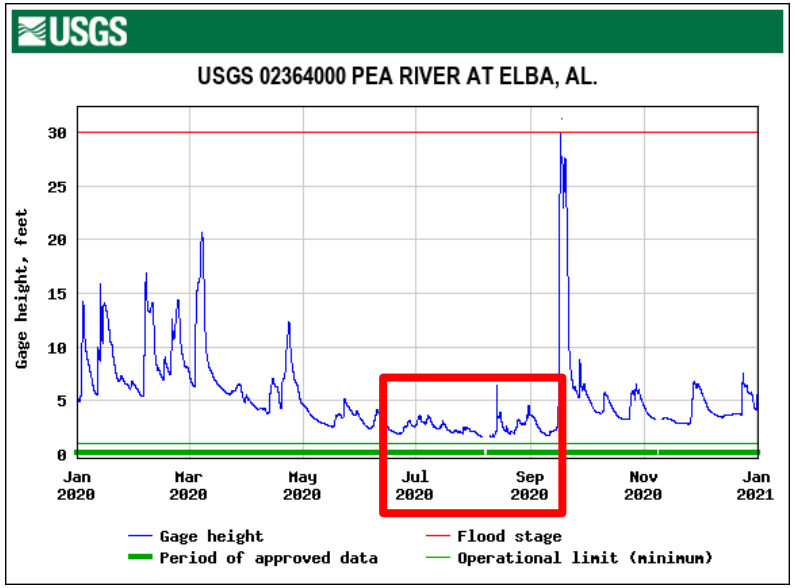
The Pea River watershed

19 unionid species

- 5 federally-listed
- Thermal tolerance of majority unknown

July avg. maximum air temperature: 92°F



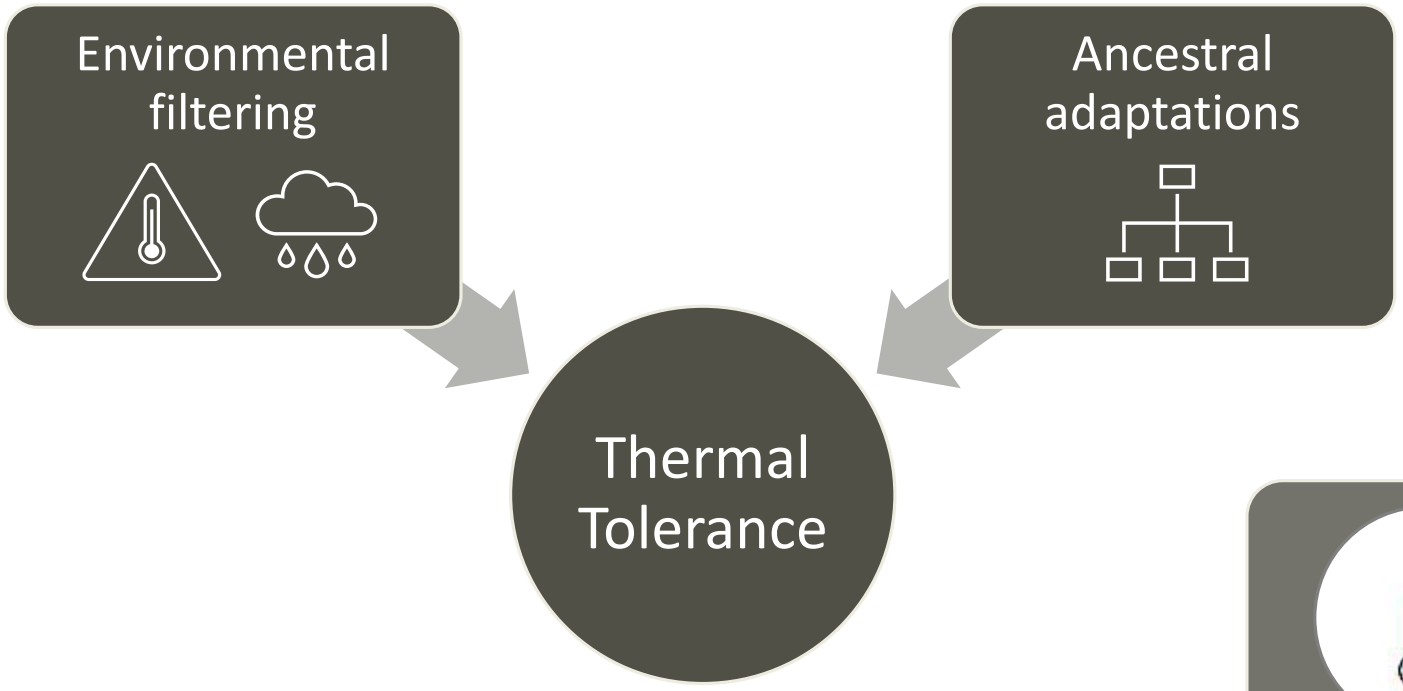


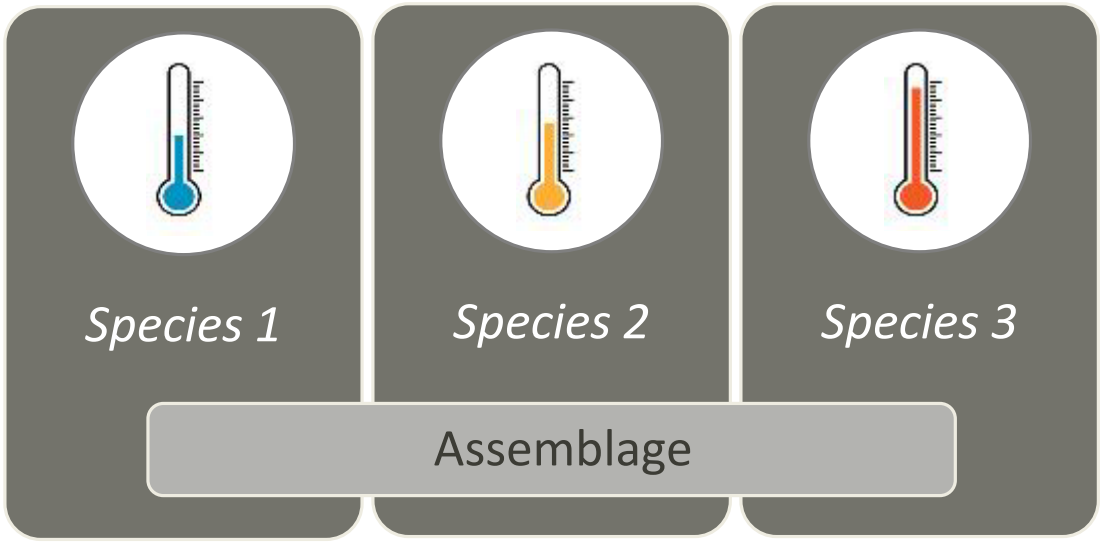
+ Global trend ↑°C

+ ↑ Water withdrawals

=

Freshwater Mussel Thermal Tolerance





Freshwater Mussel Thermal Tolerance

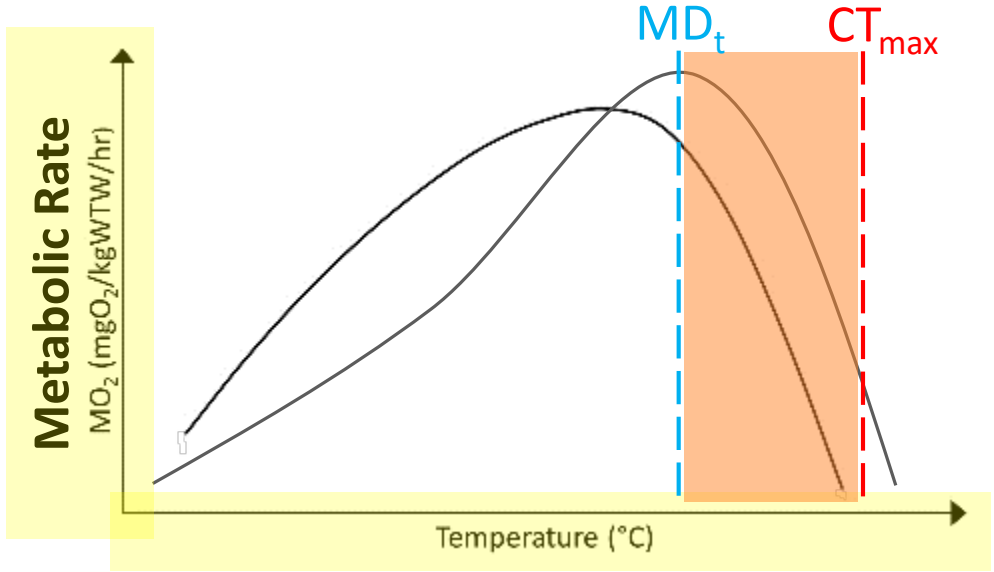
Sublethal

Physiological (MD_t)

Behavioral

Reduced performance

Metabolic Depression



Lethal

CT_{max}

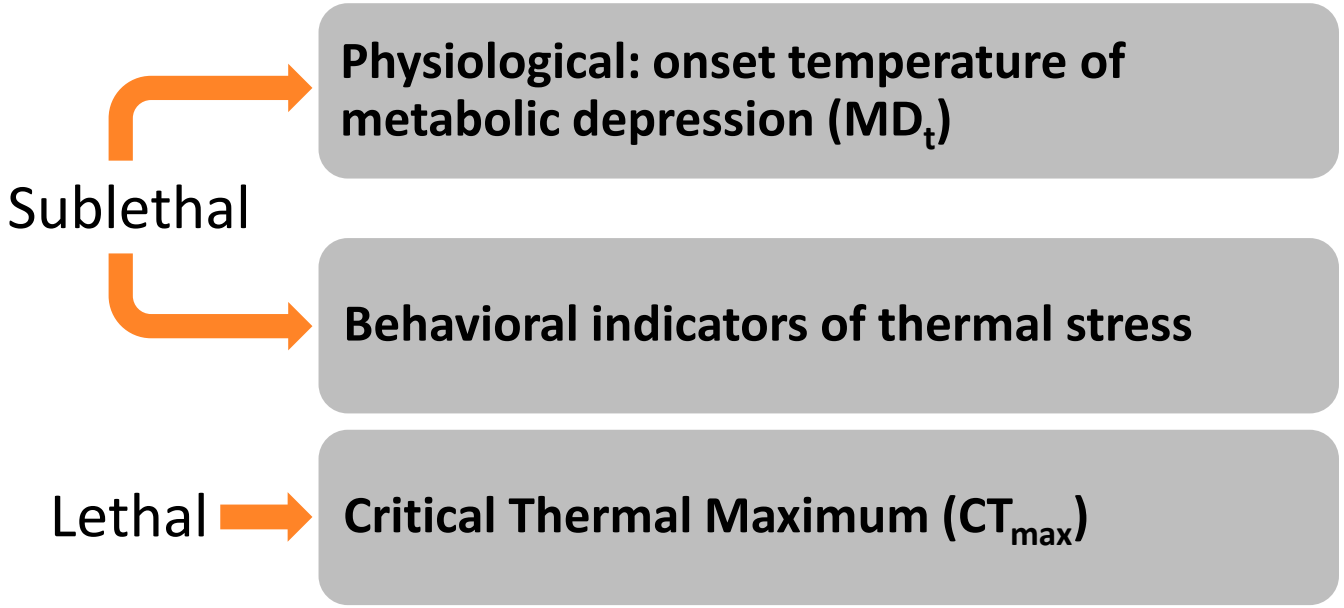
Mortality

Research Question & Objectives

Do sublethal and lethal measures of thermal tolerance differ among sympatric unionids?

1) Quantify interspecific differences in measures of thermal tolerance

2) Compare the order in which measures of thermal tolerance occur



Methods

Acclimation to initial experimental temperature

- ✓ Ambient temperature (~23-24°C) >2 weeks
- ✓ + 1°C/day to 25°C
- ✓ 25°C 1-2 weeks

Acclimation to chambers

- ✓ Experimental conditions identical to holding
- ✓ Starved for 24 hours
- ✓ System ~12 hours

Elliptio pullata
'Gulf spike'
N= 16

Distribution:
Gulf Coast drainages from AL - FL

Leaunio leinosus
'Little spectacle case'
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Lampsilis straminea
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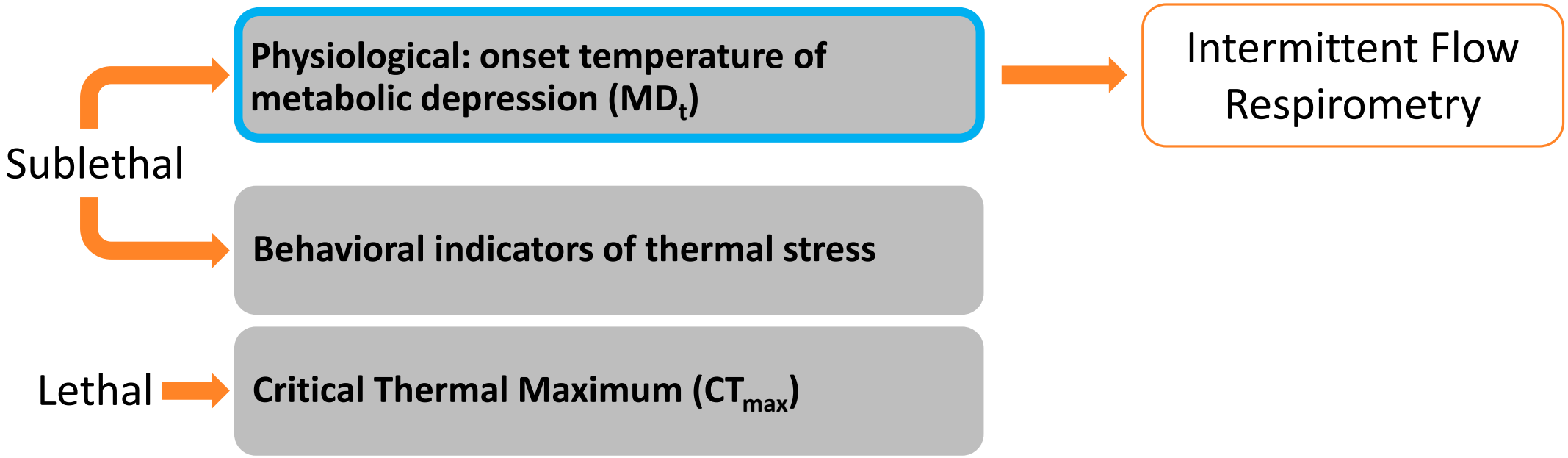
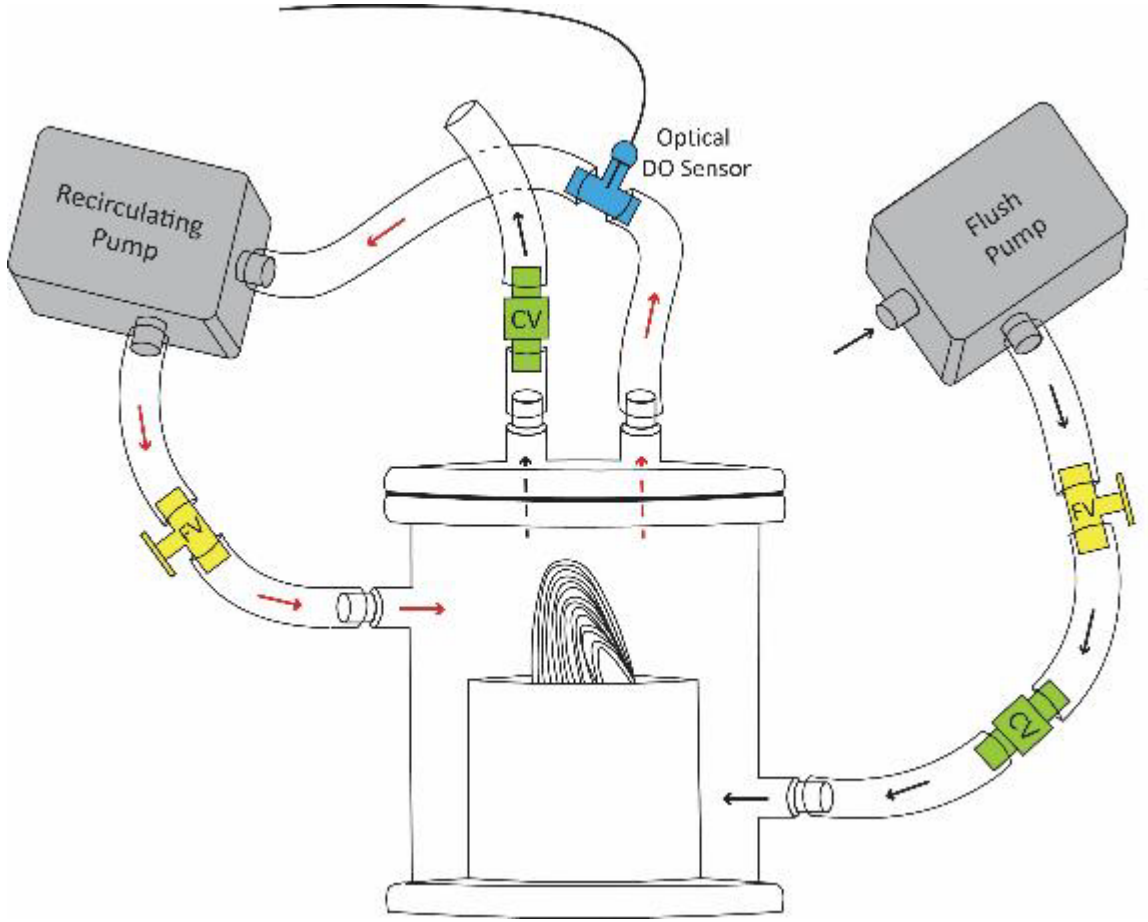
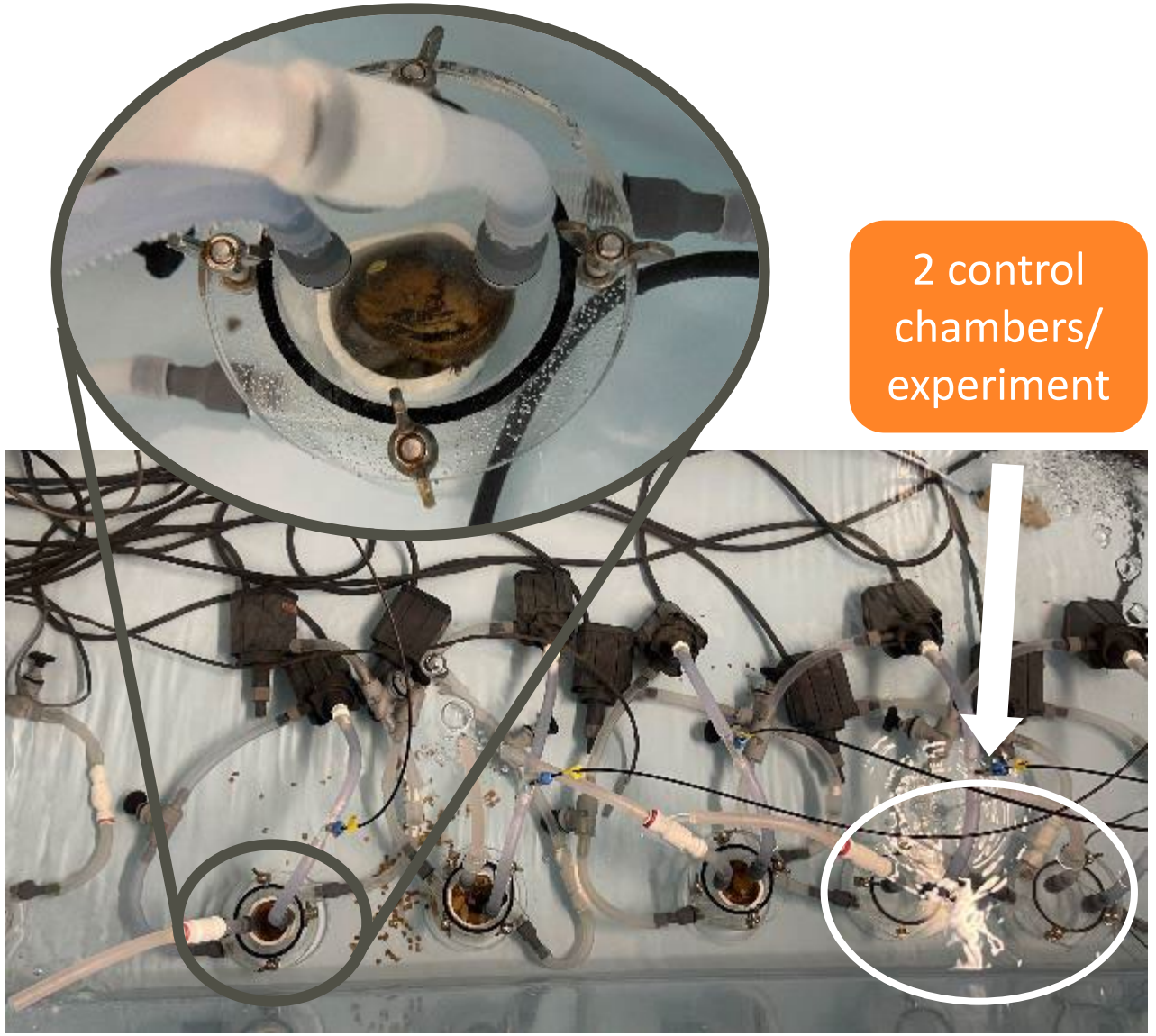


Methods: Intermittent Flow Respirometry

Physiological: onset temperature of metabolic depression (MD_t)



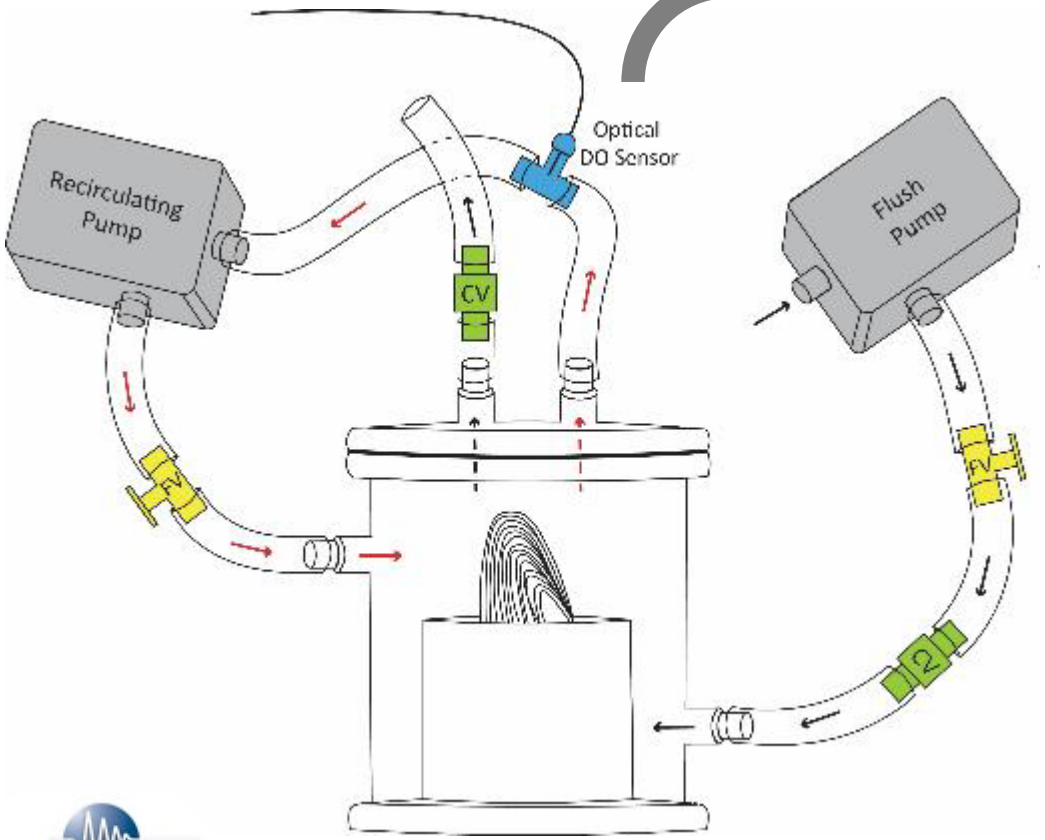


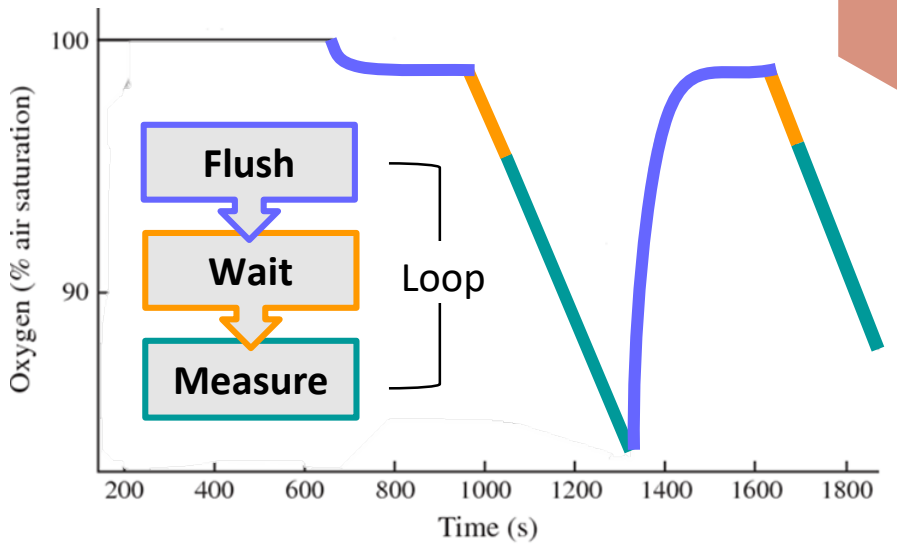
2 control chambers/ experiment

Methods: Intermittent Flow Respirometry

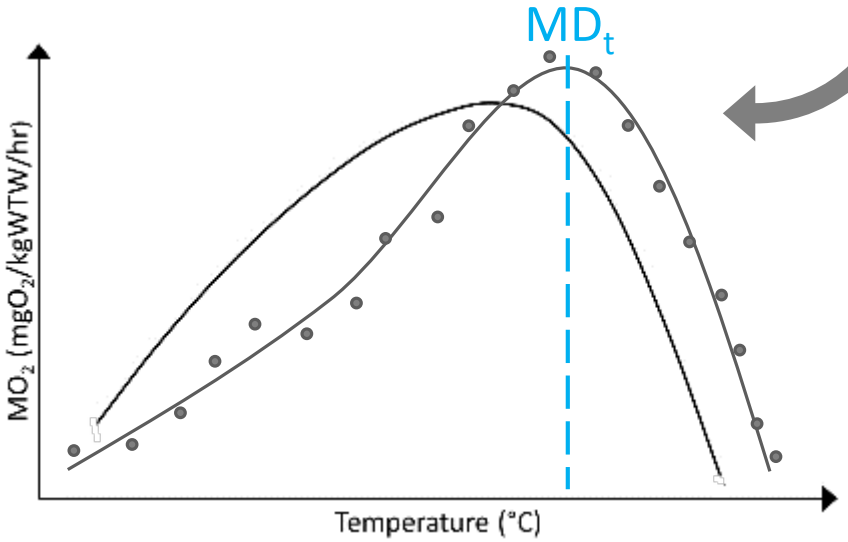
+ 2°C/ hour

Physiological: onset temperature of metabolic depression (MD_t)





Resting Metabolic Rate (RMR)



Loligo® Systems

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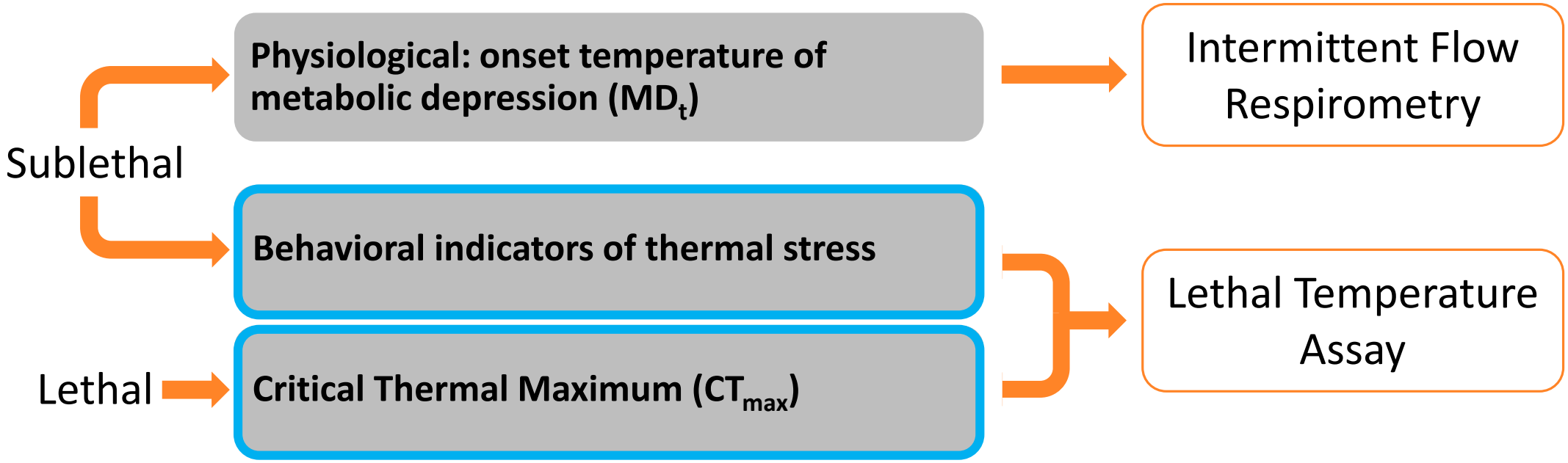

Methods: Lethal Temperature Assay

+ 2°C/ hour

Sublethal — **Behavioral indicators of thermal stress**

Lethal — **Critical Thermal Maximum (CT_{max})**

1) Foot extension
2) Gaping valves (responsive)
3) Retraction of mantle tissue and siphons
4) Unresponsive to probing

*Galbraith et al. 2012

Foot extension ✓ → Stress → Gaping valves ✓ → Stress → Retraction of mantle tissue ✓

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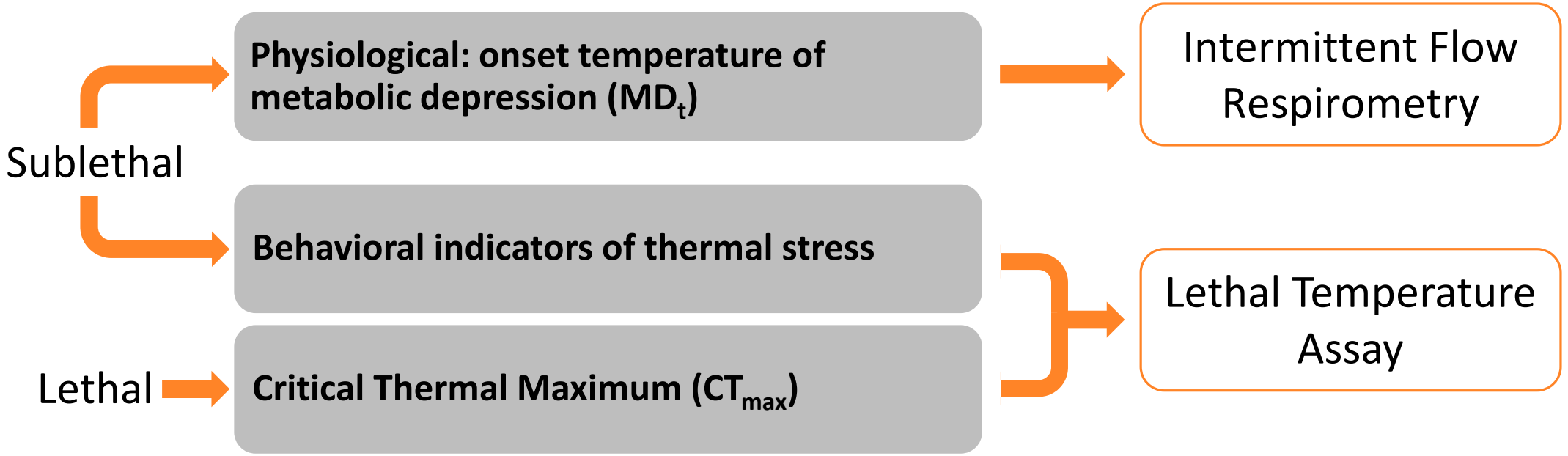
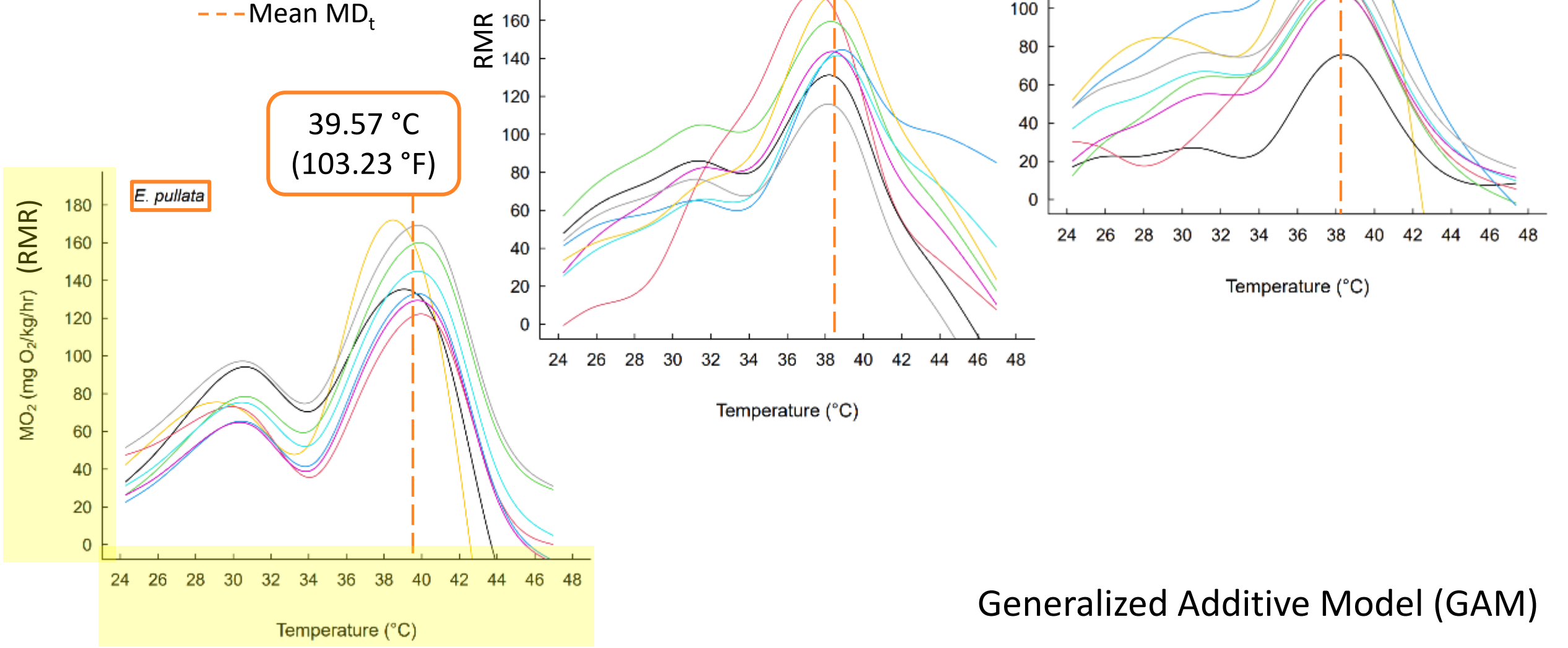


Results:

Physiological: onset temperature of metabolic depression (MD_t)

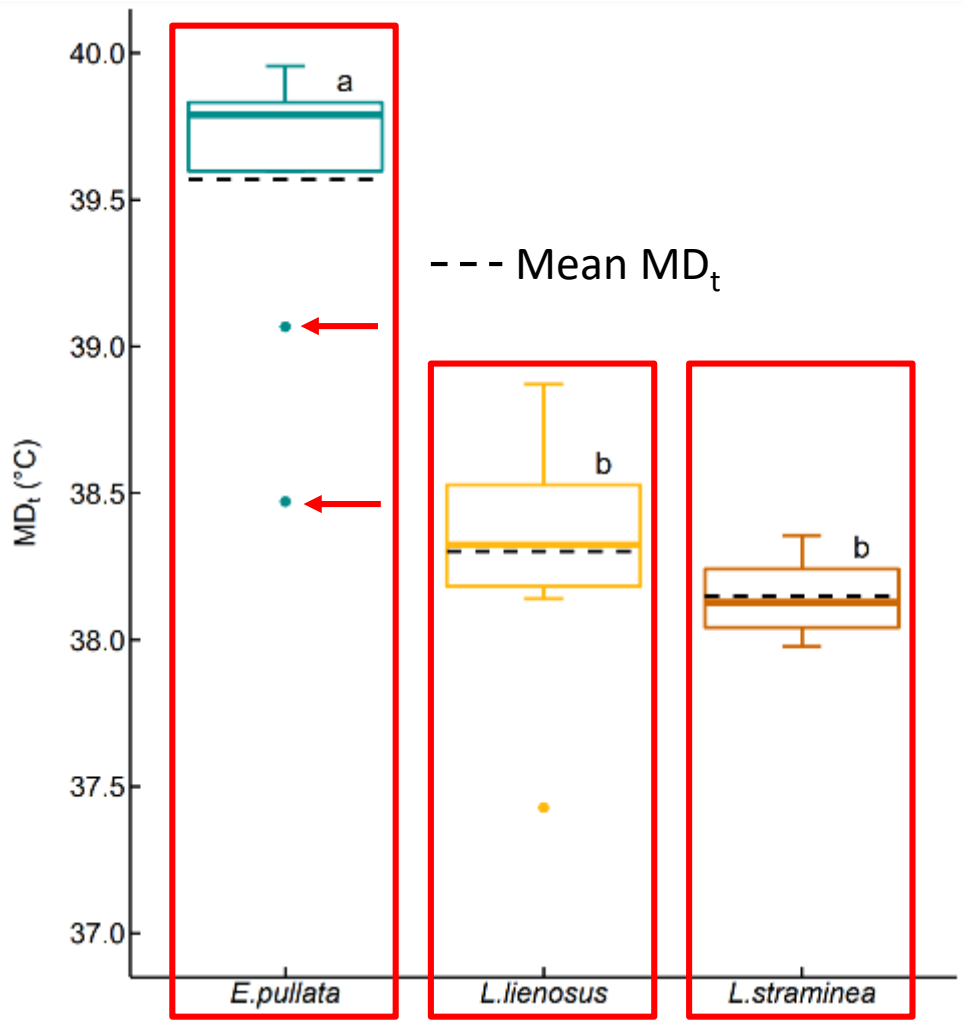


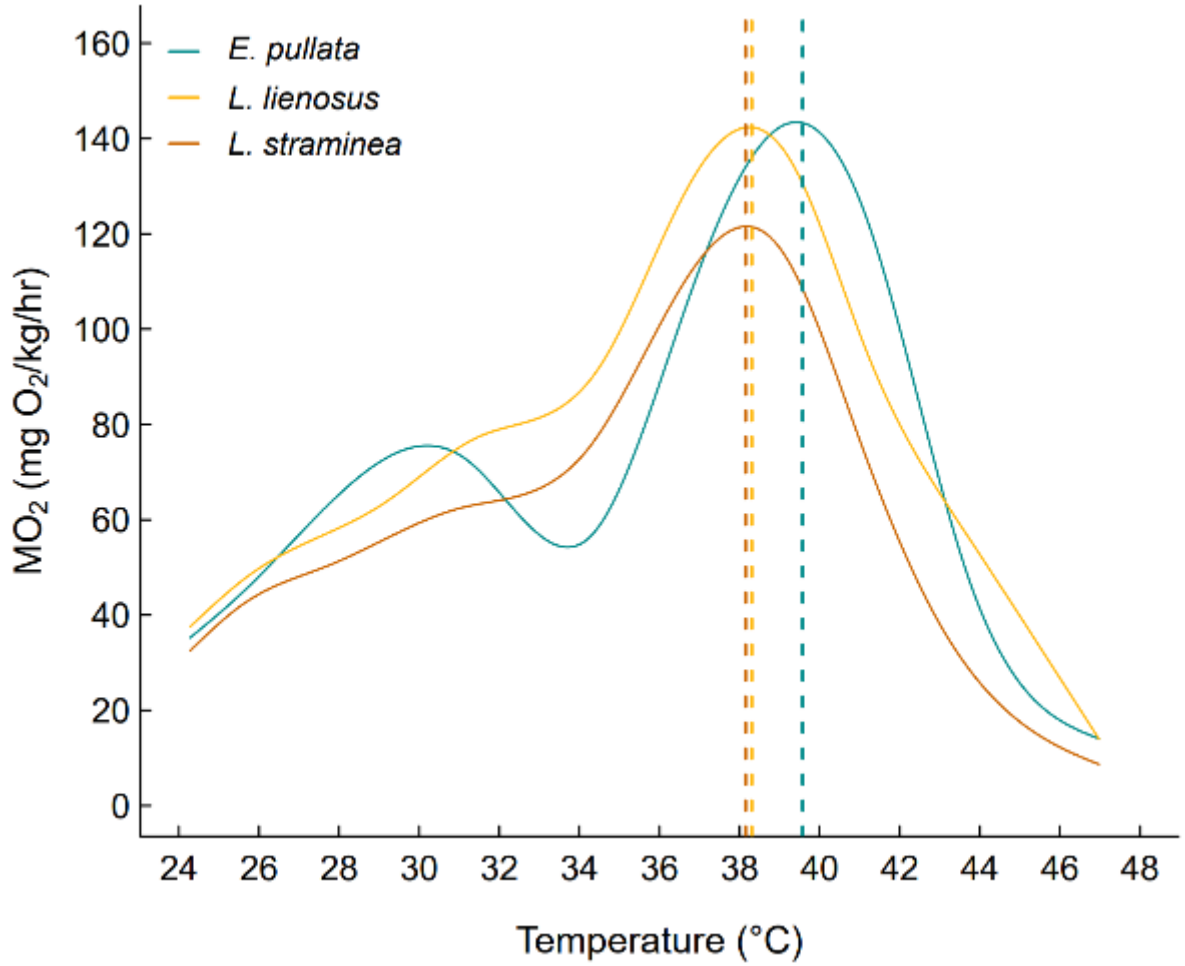
Generalized Additive Model (GAM)

Results:

Onset temperature of metabolic depression (MD_t)

MD_t varies among sympatric species ($F_{2,21}$= 30.73, $p < 0.001$)





Results:

No difference in temperature at which stress behaviors occur

No difference in upper thermal limit

Behavioral indicators of sub-lethal thermal stress

Foot extension

N= 23

($F_{2,20}$= 0.21, p= 0.81)

Gaping valves

(responsive)

N= 19

($F_{2,16}$= 0.19, p= 0.83)

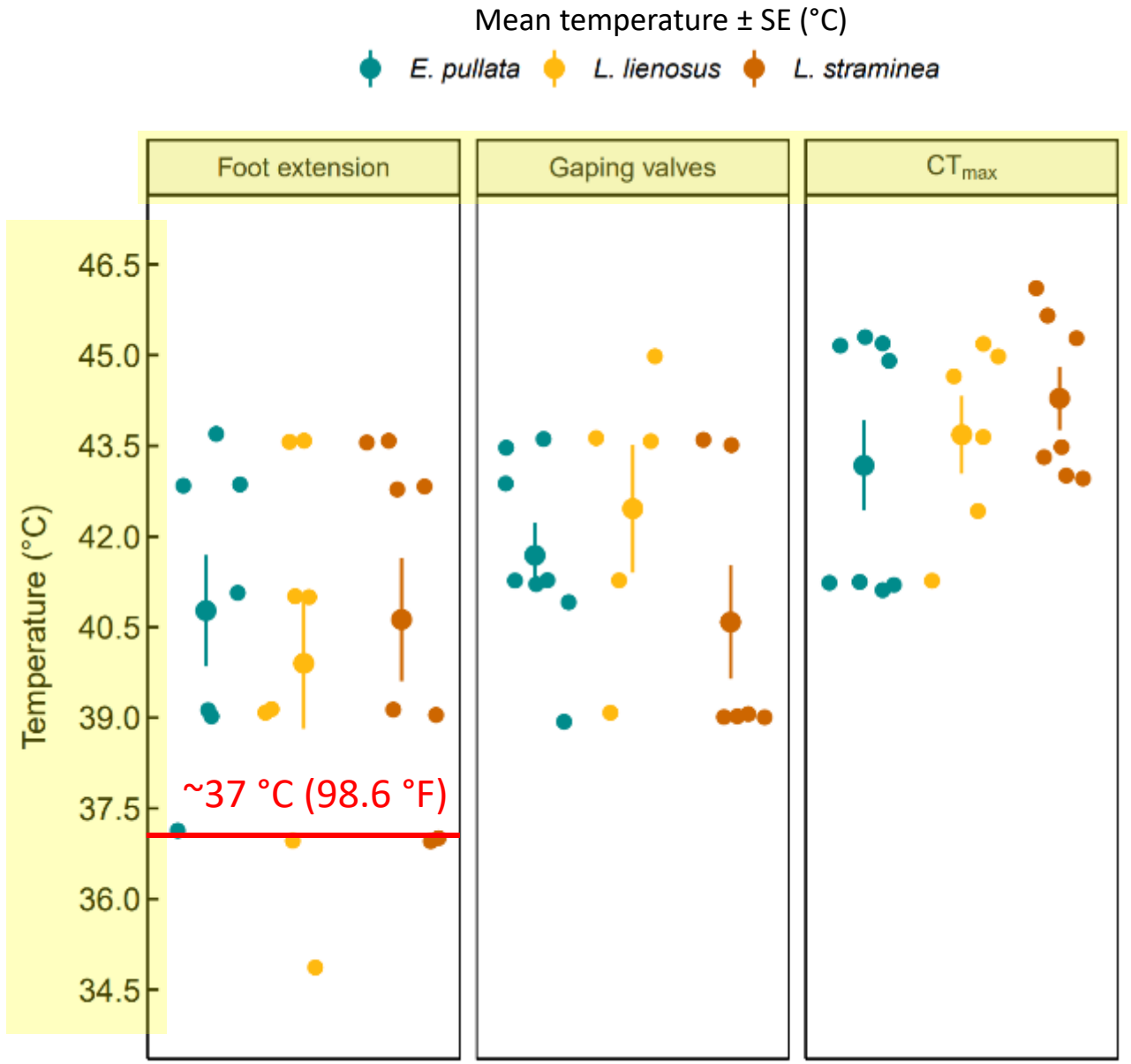
Critical Thermal Maximum (CT_{max})

(Gaping valves + unresponsive)

N=21

($F_{2,18}$ = 0.75, p= 0.49)

*2 *L. lienosus*, 1 *L. straminea* closed on extended foot



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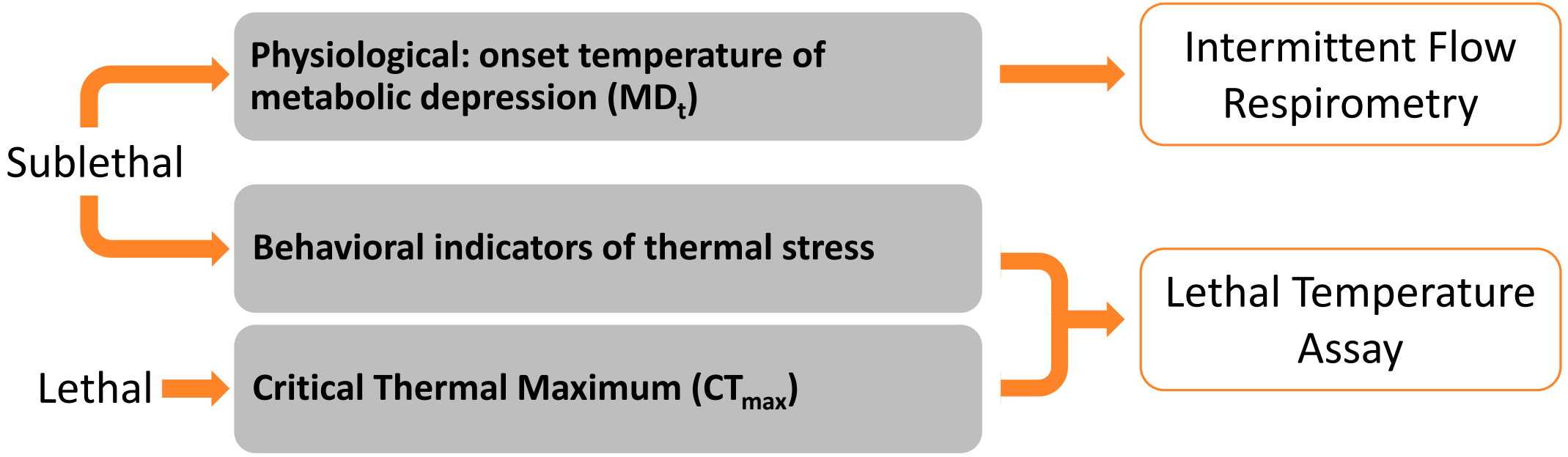
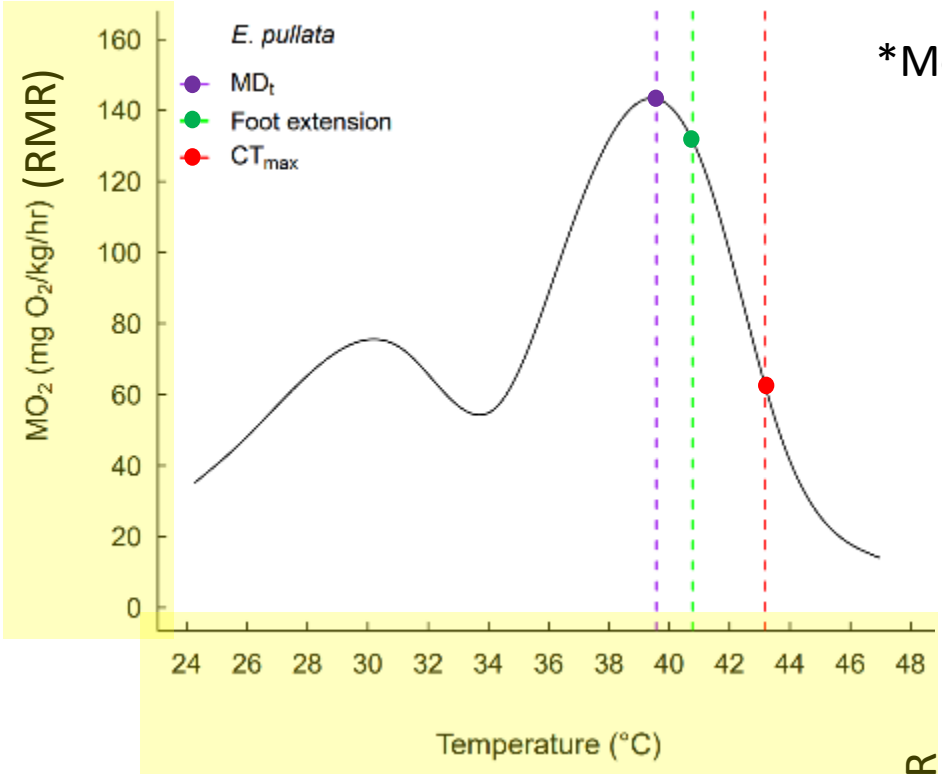
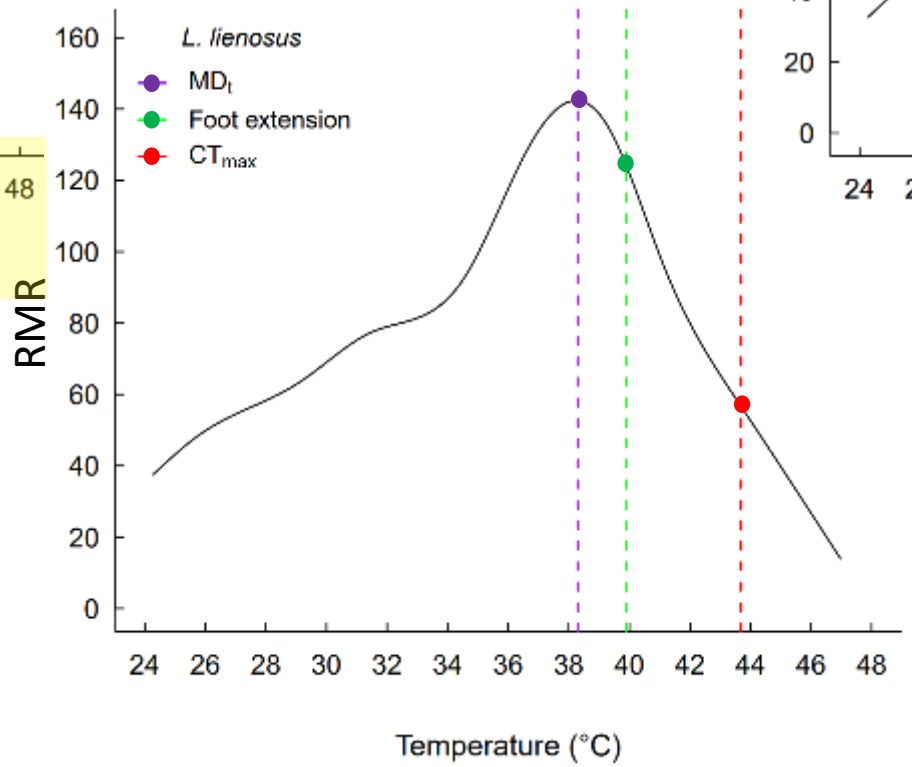


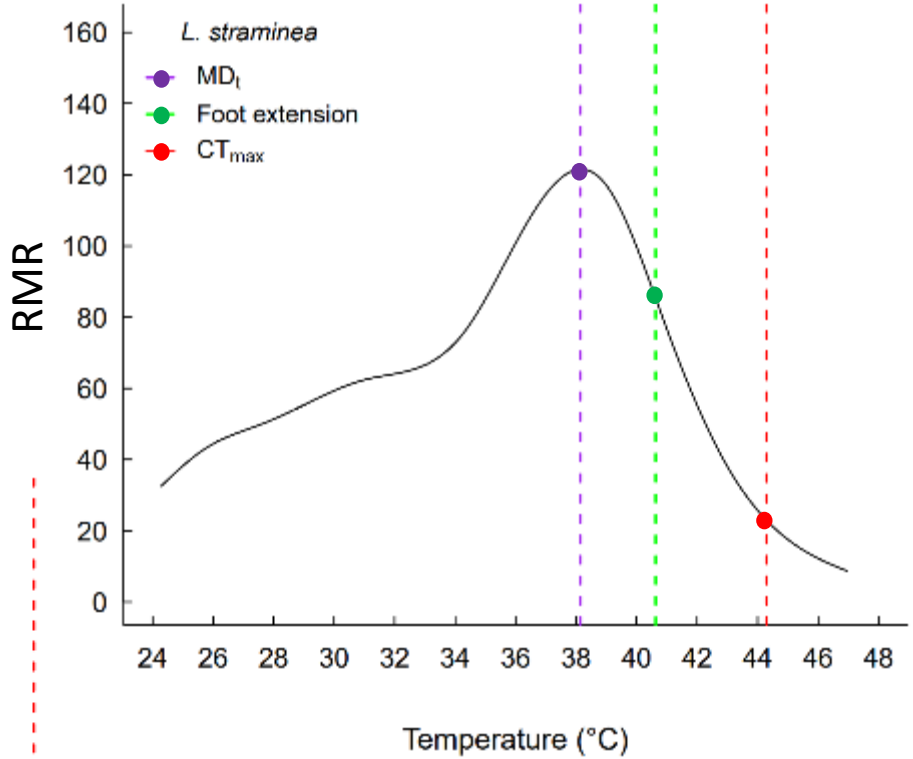
Results:

Physiological indicator occurred before behavioral indicators of thermal stress



*Mean response by species depicted

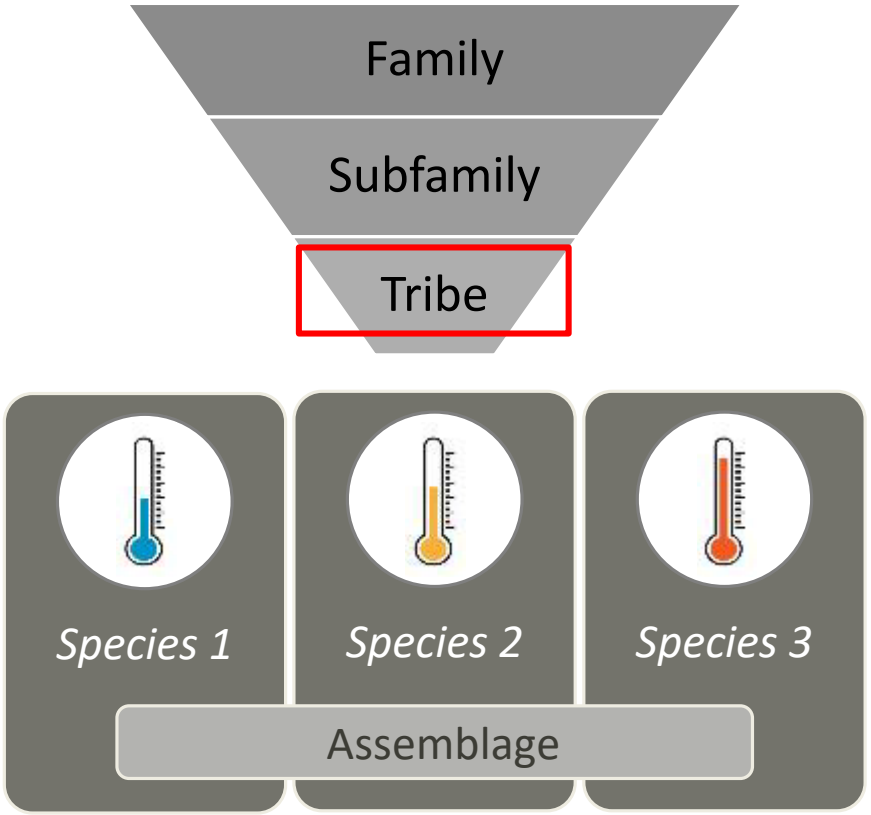




Discussion

Thermal tolerance differs significantly among sympatric species for…

Physiological: onset temperature of metabolic depression (MD_t)



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Lampsilis straminea
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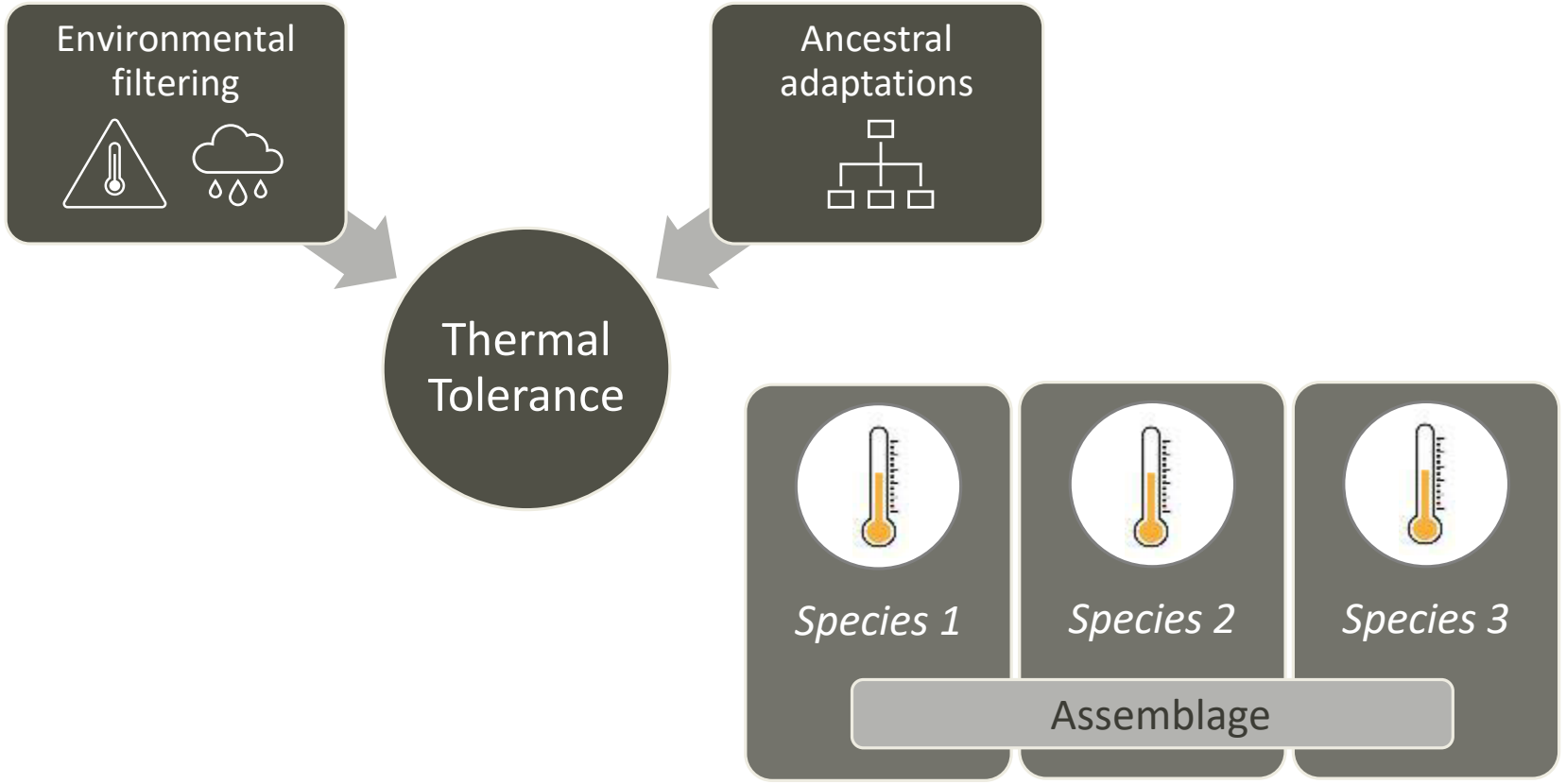
Distribution:
Gulf Coast drainages

Discussion

Thermal tolerance does not differ significantly among sympatric species for…

Behavioral indicators of thermal stress

Critical Thermal Maximum (CT_{max})



True for rare species?

Additional assemblages?

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