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Variation in traits that influence invasion success in clones of the New Zealand mud snail, *Potamopyrgus antipodarum*

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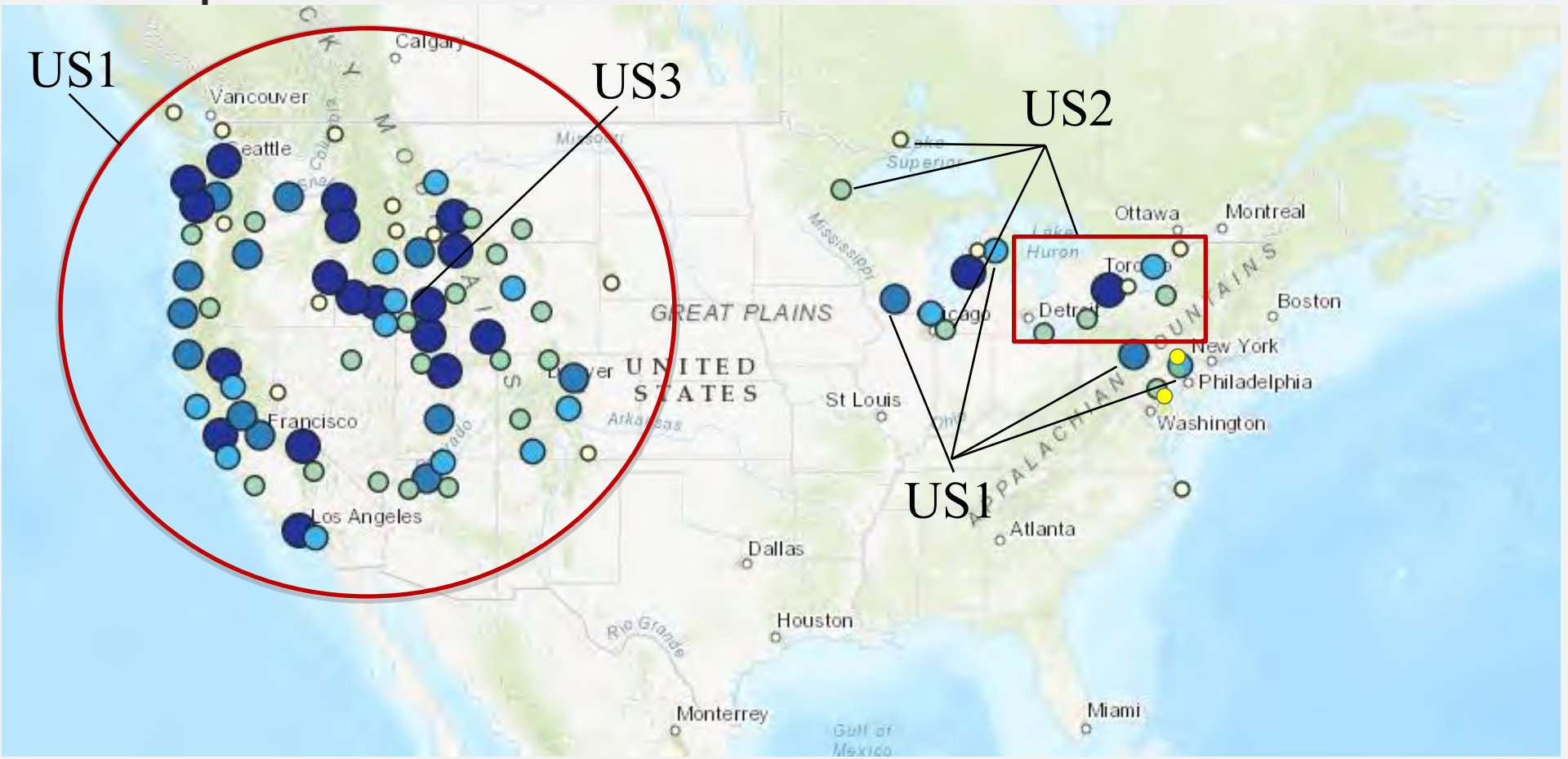
DISTRIBUTION OF THE NEW ZEALAND MUD SNAIL

Global Invasive Species Database, photo by D. Gustafson

Photo: R. Draheim

THE NEW ZEALAND MUD SNAIL

Multiple introduced clones in North America



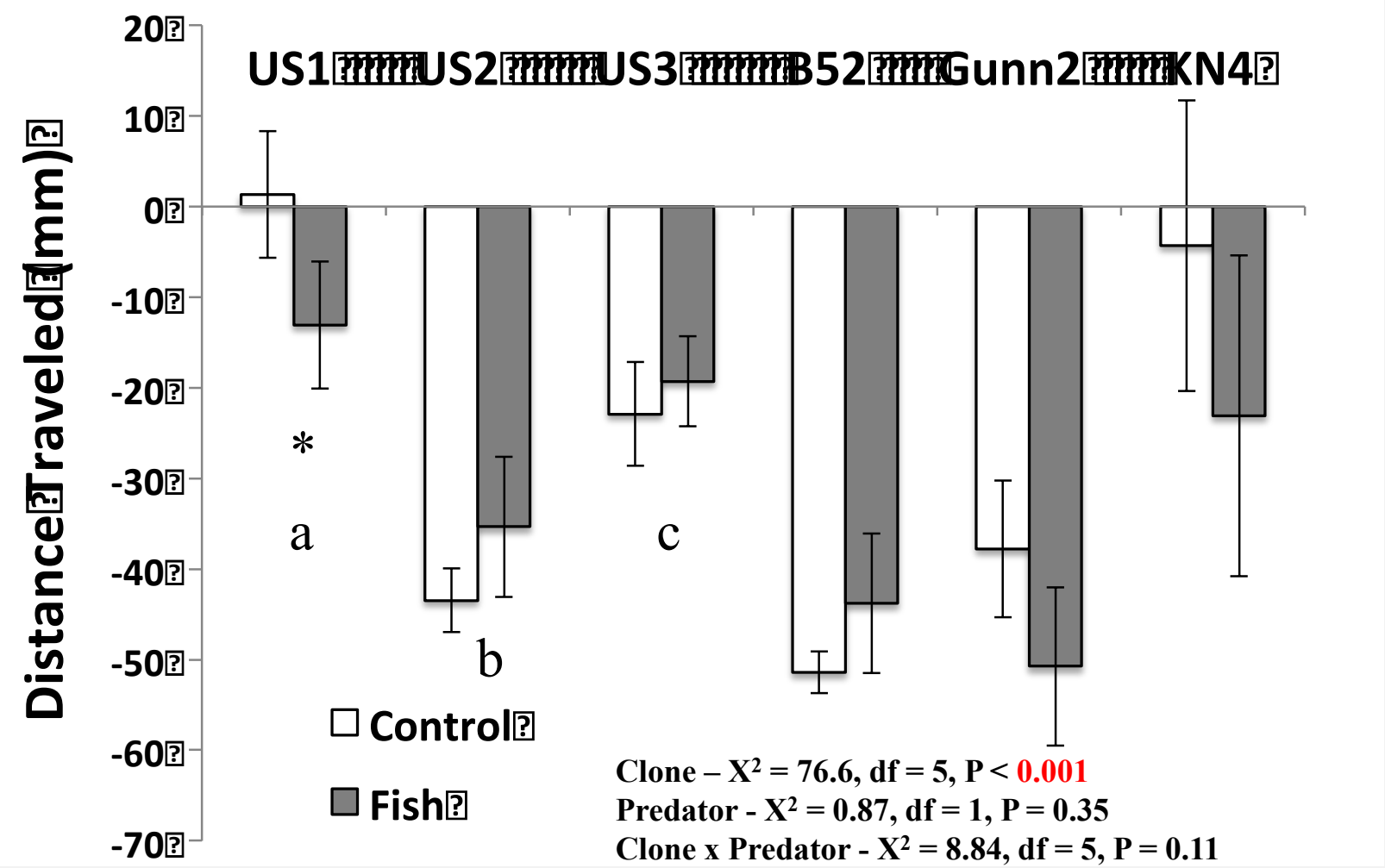
Variation within a species in invasion success

Does the invasive NZMS exhibit variation in response to a potential predator?

- **Geotaxis**
- **Photokinesis**

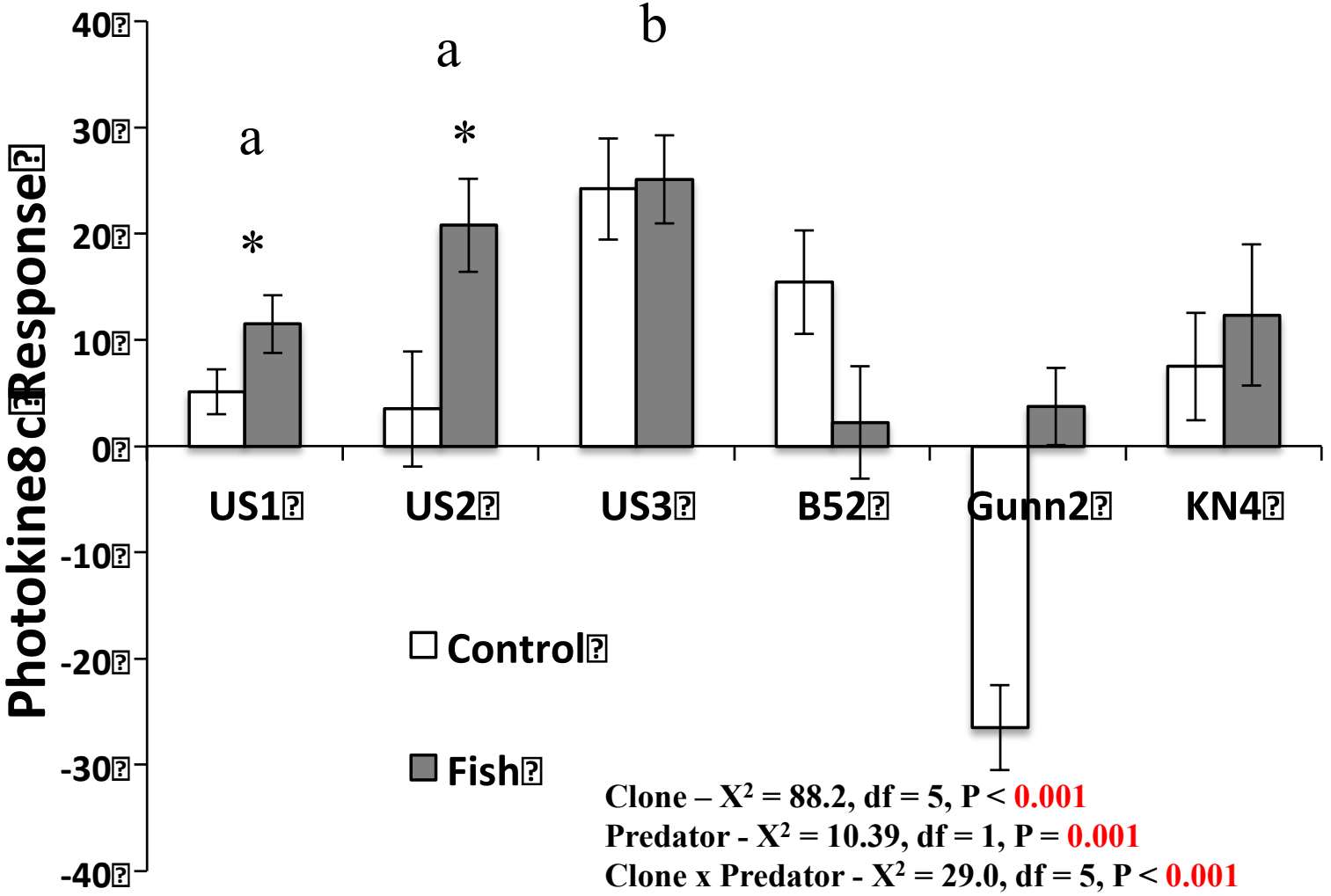
USGS

Geotactic response to Fish Odor



Levri et al. 2017 Aquatic Invasions

Photokinetic response to Fish Odor

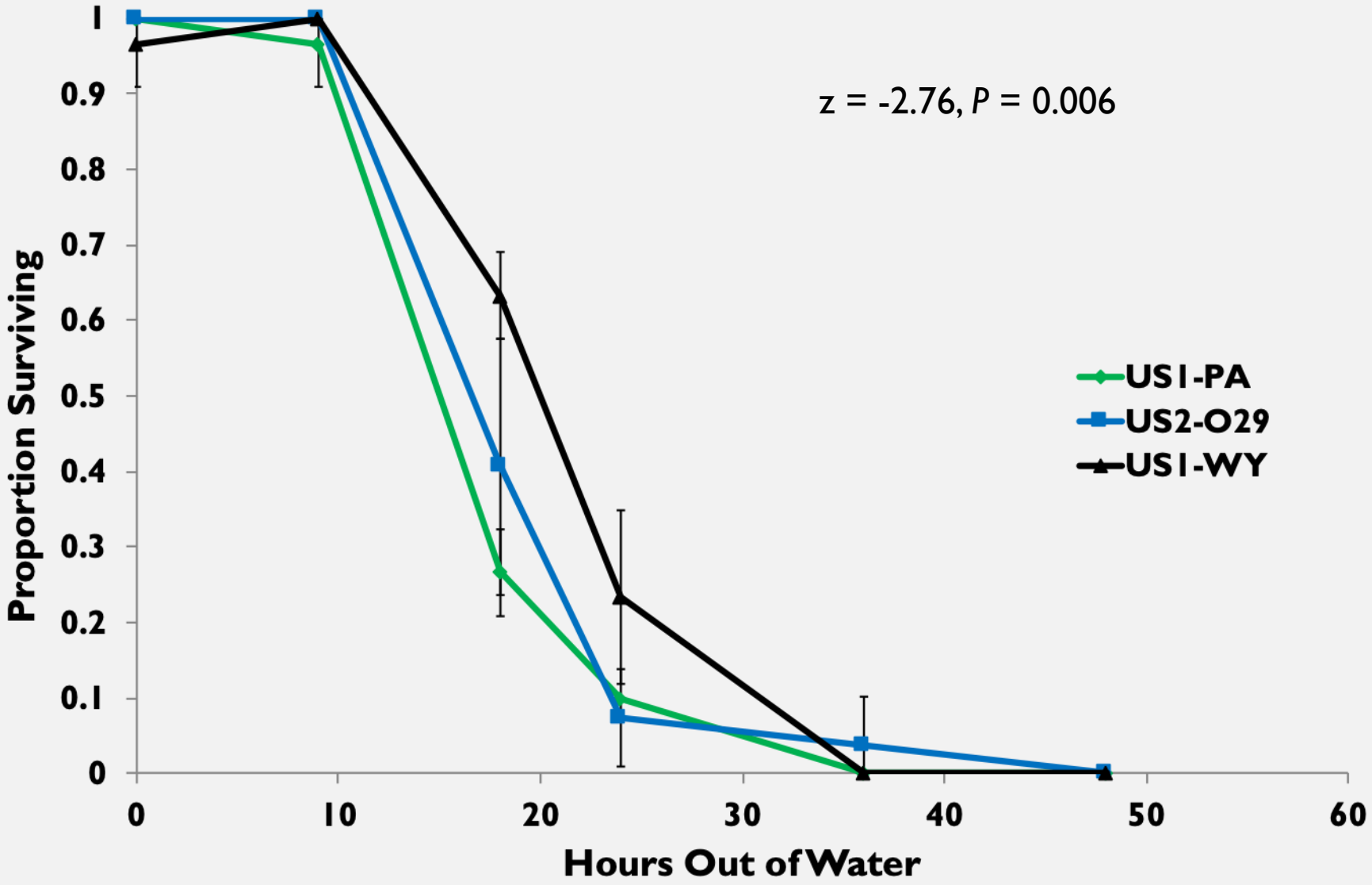


Levri et al. 2017 Aquatic Invasions

Does desiccation tolerance vary between different populations of the NZMS?

Hours out of water	US1-WY	US1-PA	US2-O29
0	10 10 10	10 10 10	9 9 9
9	10 10 10	10 10 10	9 9 9
18	10 10 10	10 10 10	9 9 9
24	10 10 10	10 10 10	9 9 9
36	10 10 10	10 10 10	9 9 9
48	10 10 10	10 10 10	9 9 9

Effect of population on desiccation tolerance

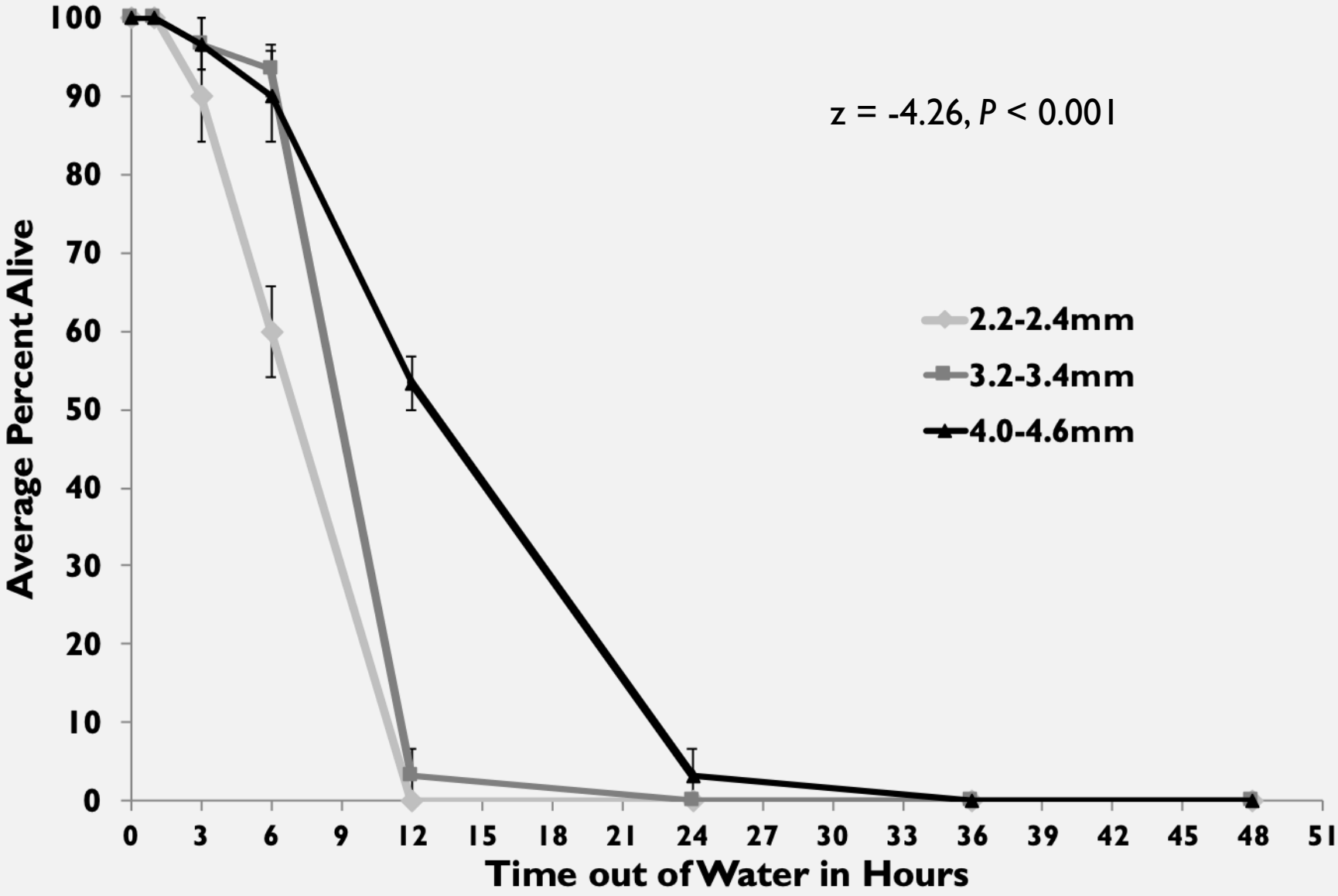


Does desiccation tolerance vary with snail size?

Used US1-PA population

Hours out of water	2.2-2.4mm	3.2-3.4mm	4.0-4.6mm
0	10 10 10	10 10 10	10 10 10
1	10 10 10	10 10 10	10 10 10
3	10 10 10	10 10 10	10 10 10
6	10 10 10	10 10 10	10 10 10
12	10 10 10	10 10 10	10 10 10
24	10 10 10	10 10 10	10 10 10
36	10 10 10	10 10 10	10 10 10
48	10 10 10	10 10 10	10 10 10

Effect of snail size on desiccation tolerance

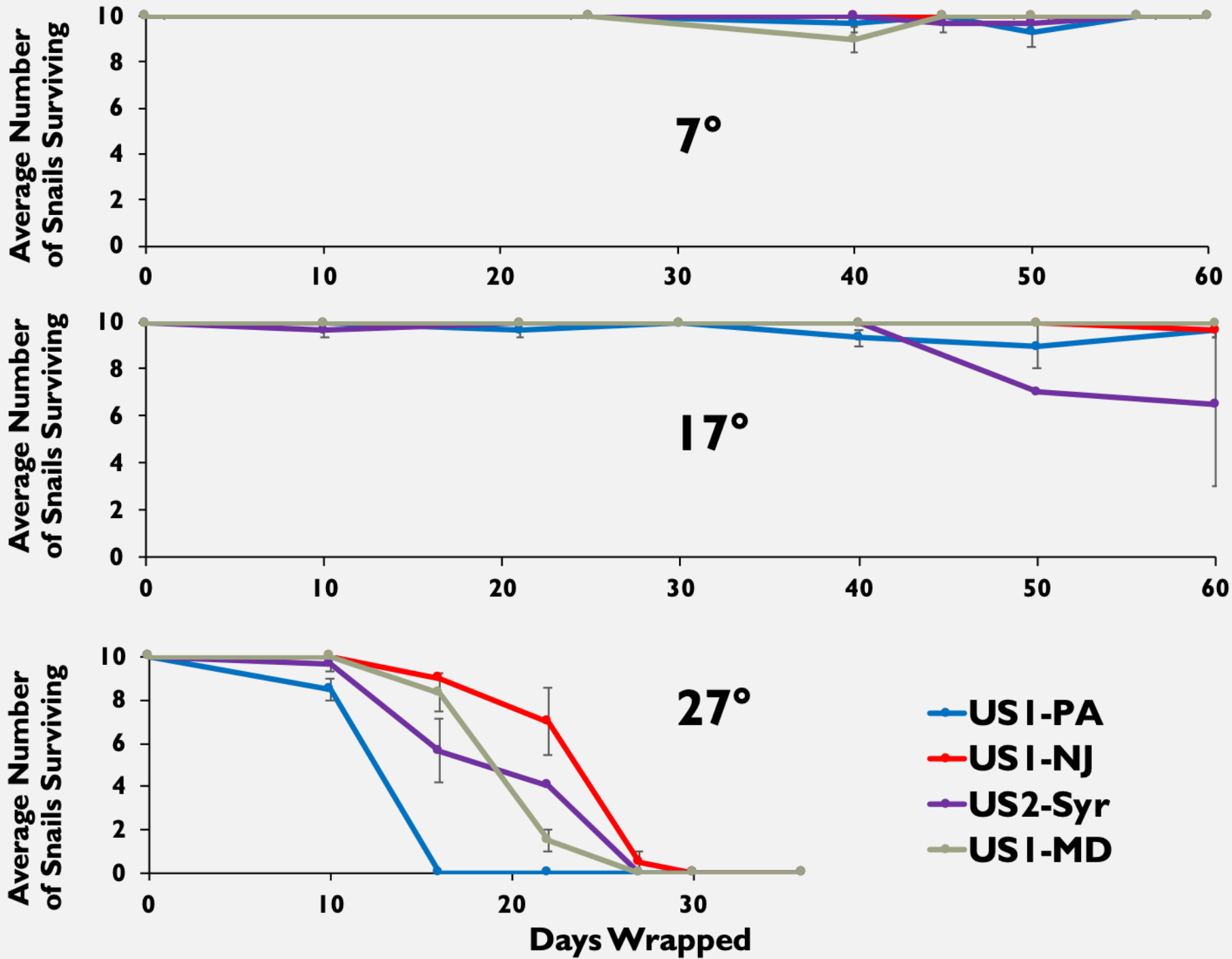


Does temperature and population influence ability to survive in moist conditions?

4 Populations used in each treatment

US1-PA, US1-NJ, US1-MD, US2-Syr

Days	7°C	Days	17°C	Days	27°C
0	10 10 10	0	10 10 10	0	10 10 10
25	10 10 10	10	10 10 10	10	10 10 10
40	10 10 10	21	10 10 10	16	10 10 10
45	10 10 10	30	10 10 10	22	10 10 10
50	10 10 10	40	10 10 10	27	10 10 10
56	10 10 10	50	10 10 10	30	10 10 10
60	10 10 10	60	10 10 10	36	10 10 10


Average Number of Snails Surviving
10
8
6
4
2
0
0
10
20
30
40
50
60
7°
17°
27°
Days Wrapped
US1-PA
US1-NJ
US2-Syr
US1-MD

CONCLUSIONS:

- Variation exists between populations of NZMS in North America in behavior and desiccation tolerance.
- Variation exists even within clonal genotype suggesting relatively rapid evolution for asexual populations.
- Larger NZMS tolerate desiccation better than smaller.
- The NZMS can survive for months out of water if simply kept moist and cool.

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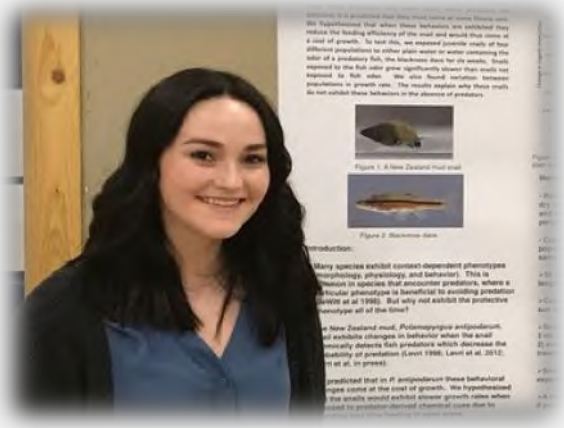
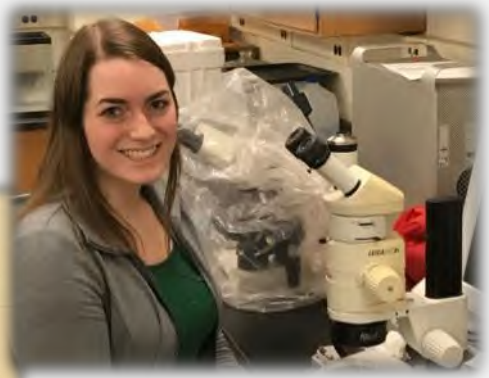
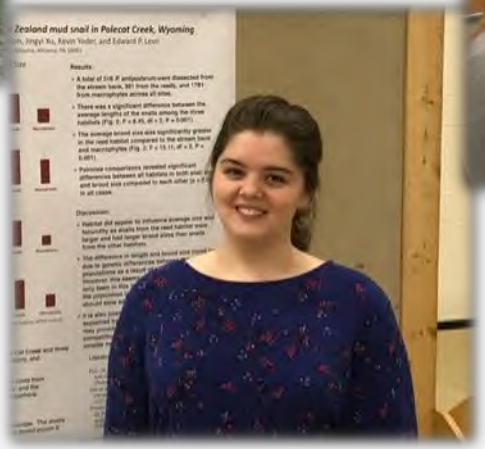
- Tessa Woods





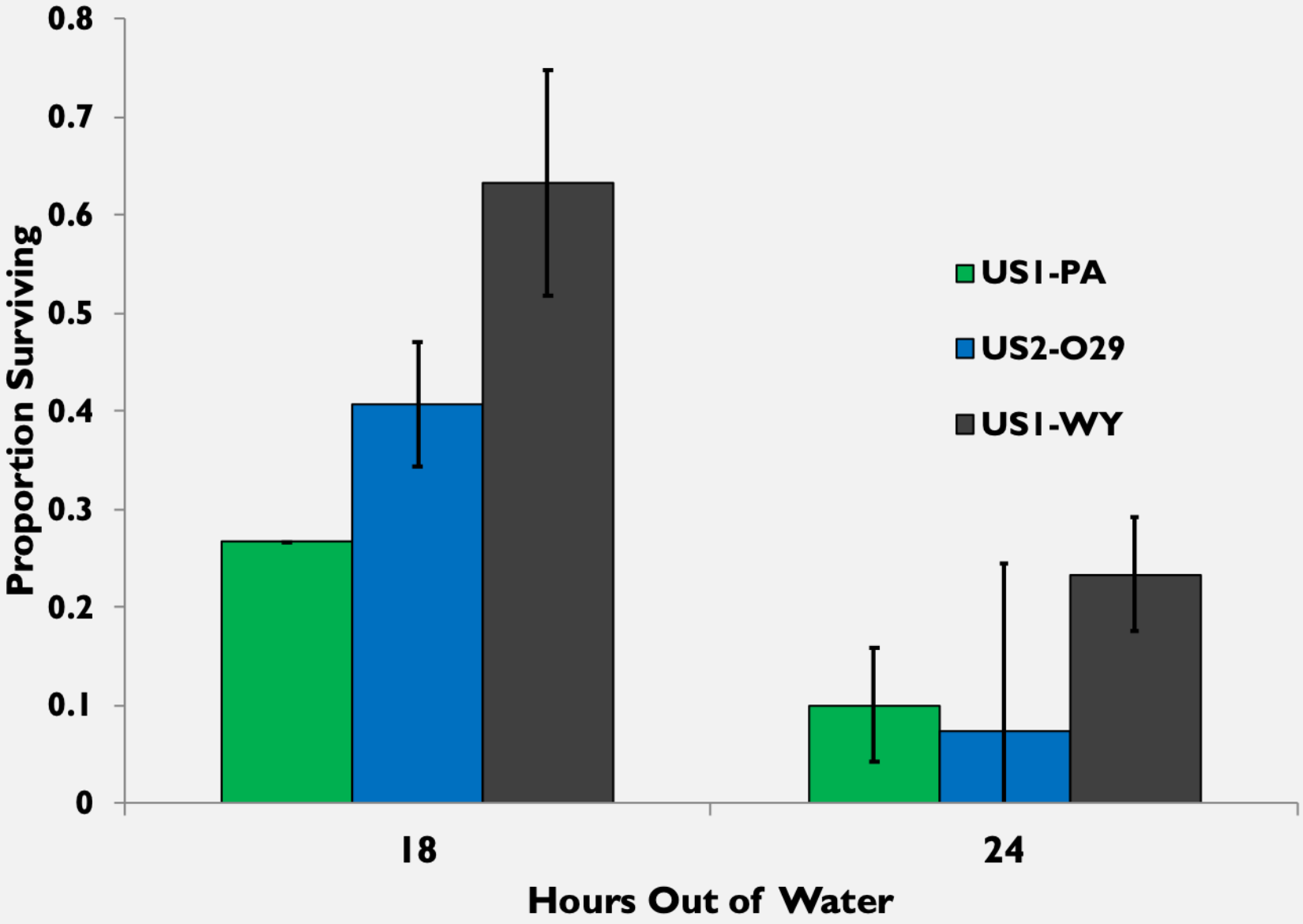


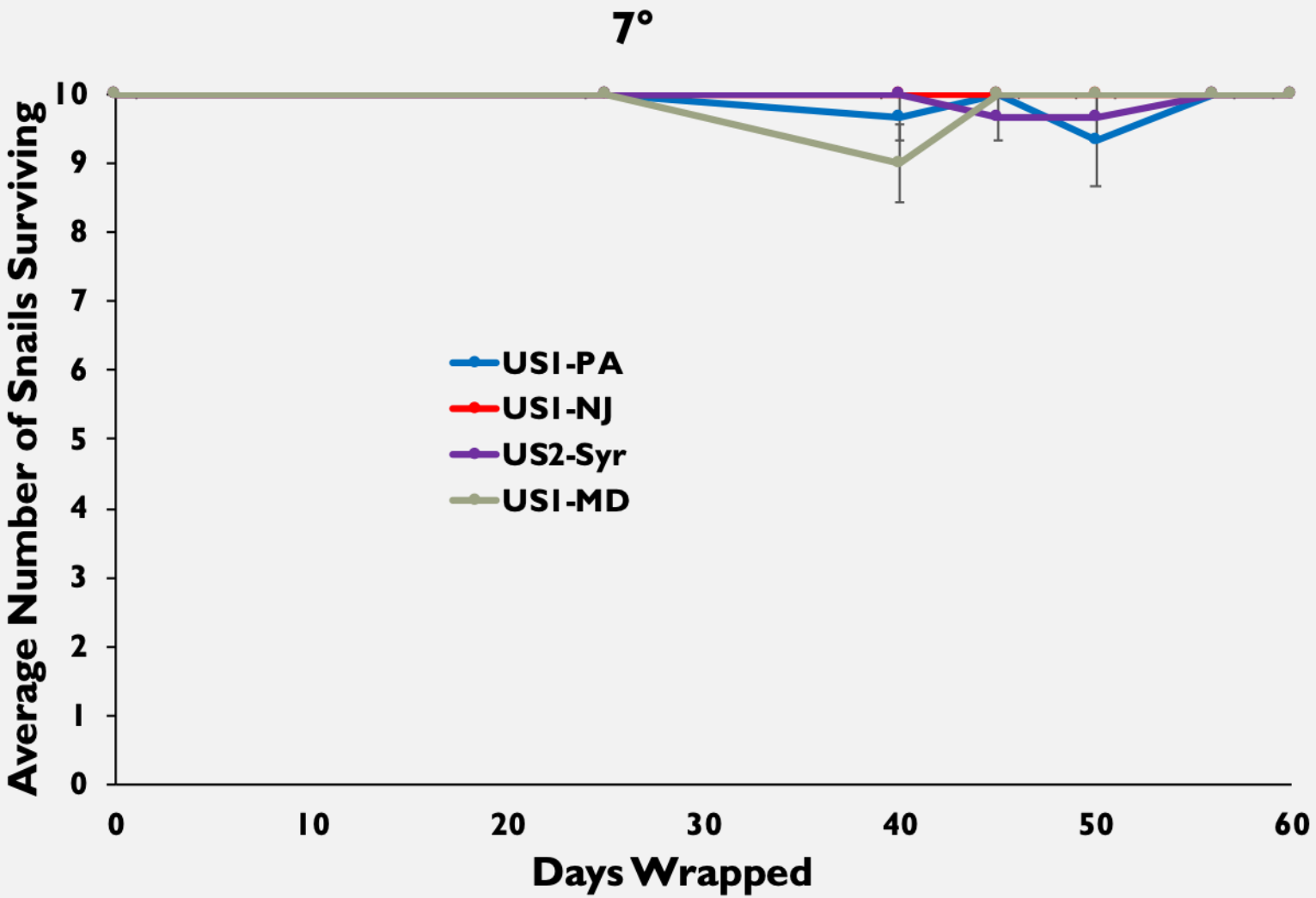
QUESTIONS?

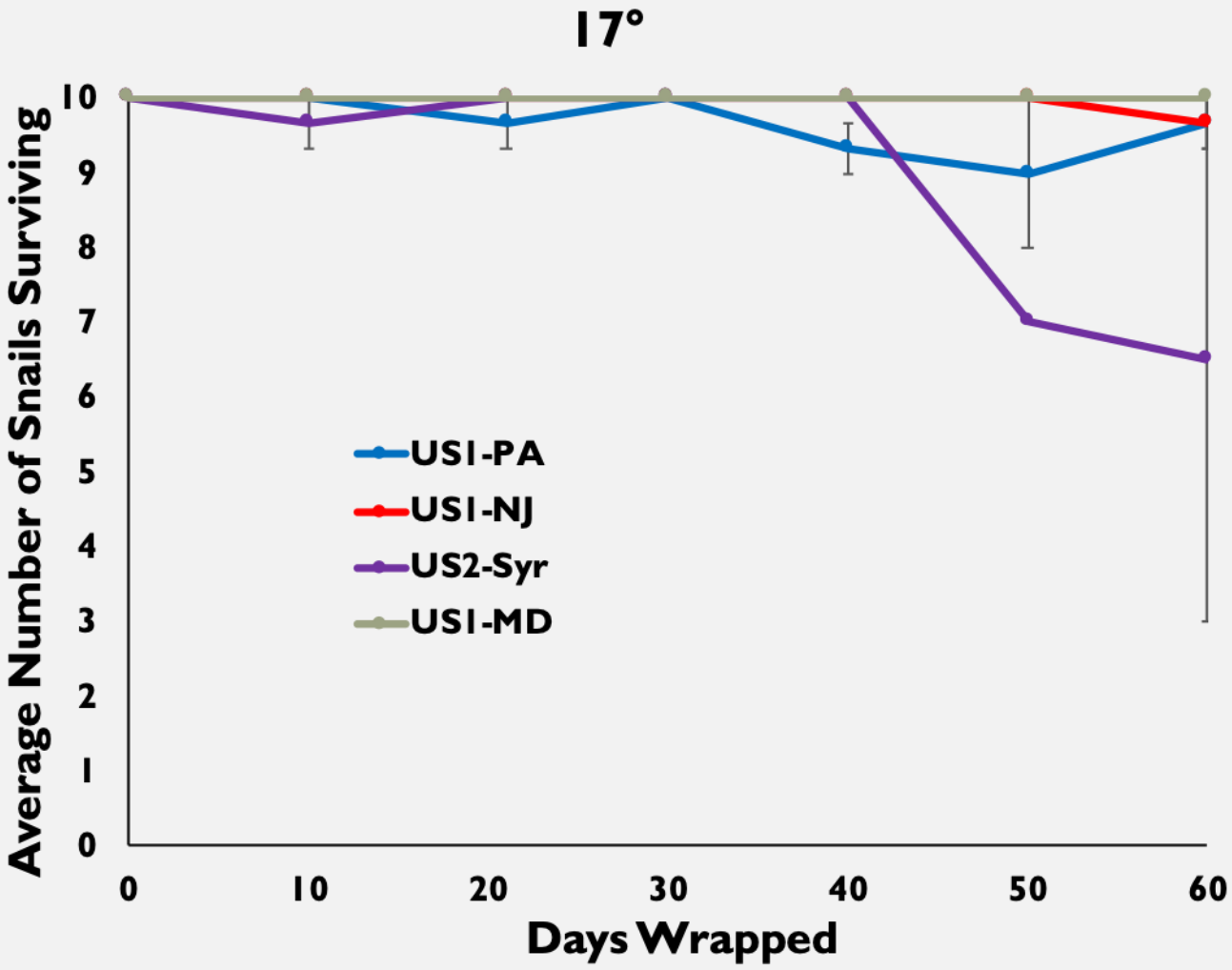

Aquatic Invasive Species Alert
New Zealand Mudsnail
New Zealand mudsnail (NZM) is in this waterway. The snails are very small, measuring less than ¼ inch, with a dark, narrow, coiled shell with deep grooves. Like other Aquatic Invasive Species (AIS), they disrupt ecosystems by rapidly multiplying and competing with native species for space and food. NZM have the potential to decrease the food supply for fish in this stream. The snails are found on rocks and vegetation and can attach to fishing gear, boats and other equipment where they can easily go unseen. Anglers, boaters, swimmers and tubers can unknowingly spread NZM!
Help Stop the Spread of NZM.
Clean Your Gear!
Check these areas
Clothing
Fishing rod, reel and line
Fishing vests
Nets and tackle
Shoes or boots
New Zealand mudsnail requires specialized disinfection measures:
• Visually inspect gear and remove and dispose of any clinging matter in the trash. Do not move mud, organic matter or NZM from this area!
• To kill NZM, three methods are effective:
✓Freeze gear for a minimum of 6 hours
✓Soak gear in hot water (120°F to 140°F) for 5 minutes. This method is not recommended for GOR-TEX®
✓Soak gear for 5 minutes in a 1 to 1 solution of Formula 409® Cleaner Degreaser Disinfectant and water. After soaking, thoroughly rinse the gear with plain water. Simply spraying gear with the disinfectant or the mixture does not work. Also, general cleaners (including other 409 products) have not been shown to be effective against NZM.
STOP AQUATIC HITCHHIKERS!
Sea Grant
Pennsylvania

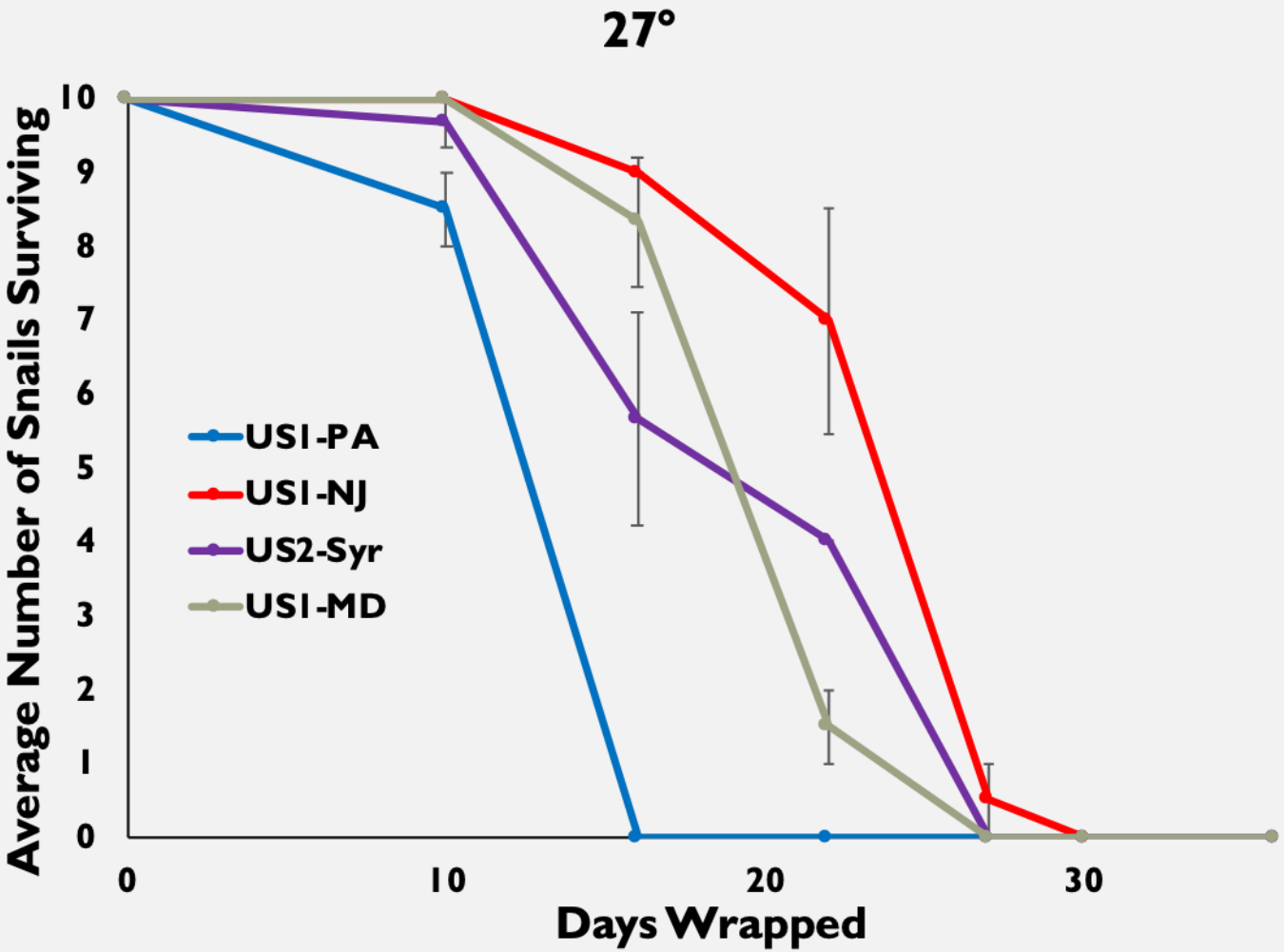
Variation within a species in invasion success

- Competitive ability
- Behavior
- Tolerance to extremes


0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Proportion Surviving
US1-PA
US2-O29
US1-WY
18
24
Hours Out of Water

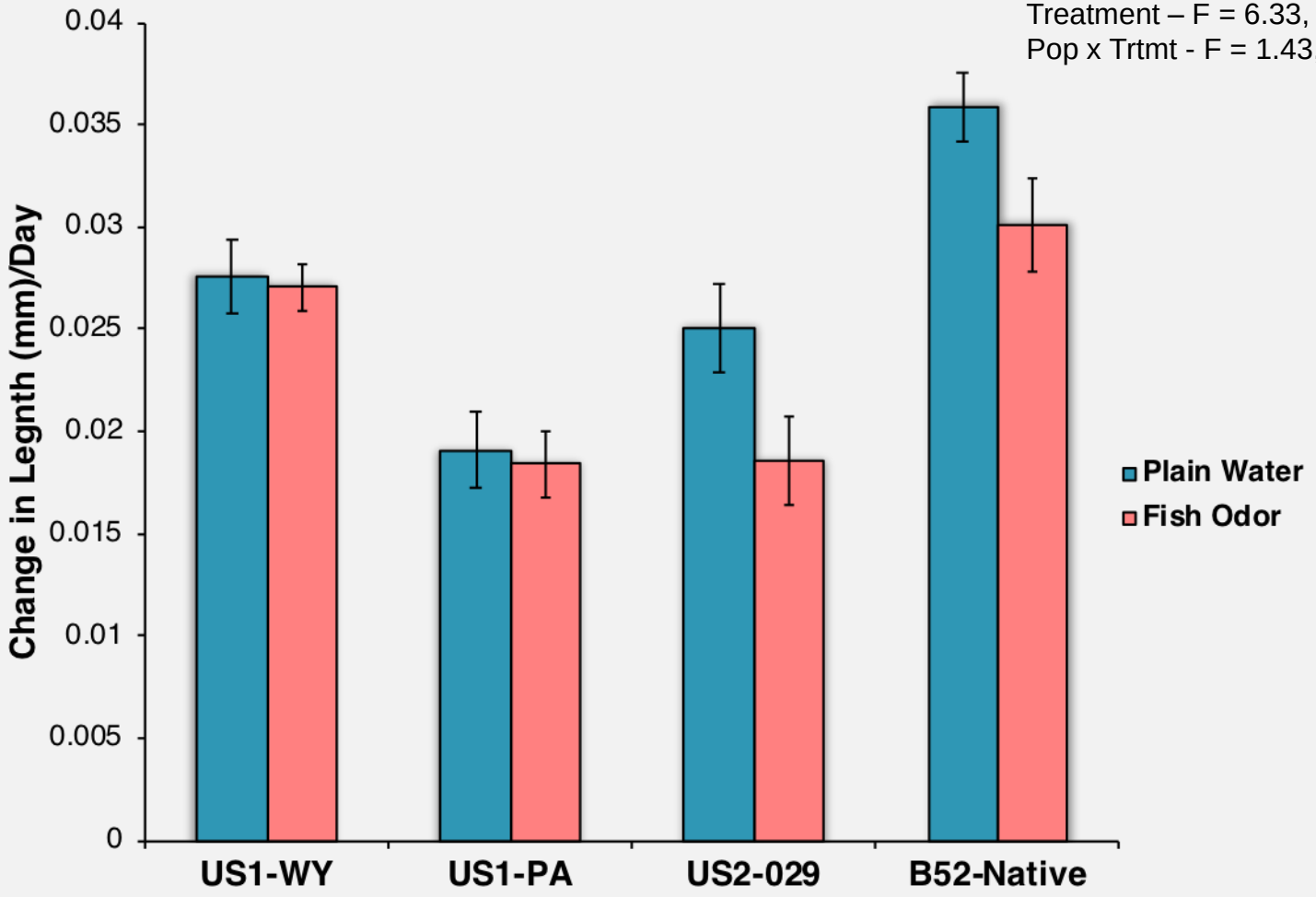

7°
Average Number of Snails Surviving
0
1
2
3
4
5
6
7
8
9
10
0
10
20
30
40
50
60
Days Wrapped
USI-PA
USI-NJ
US2-Syr
USI-MD


17°
Average Number of Snails Surviving
0
1
2
3
4
5
6
7
8
9
10
0
10
20
30
40
50
60
Days Wrapped
US1-PA
US1-NJ
US2-Syr
US1-MD

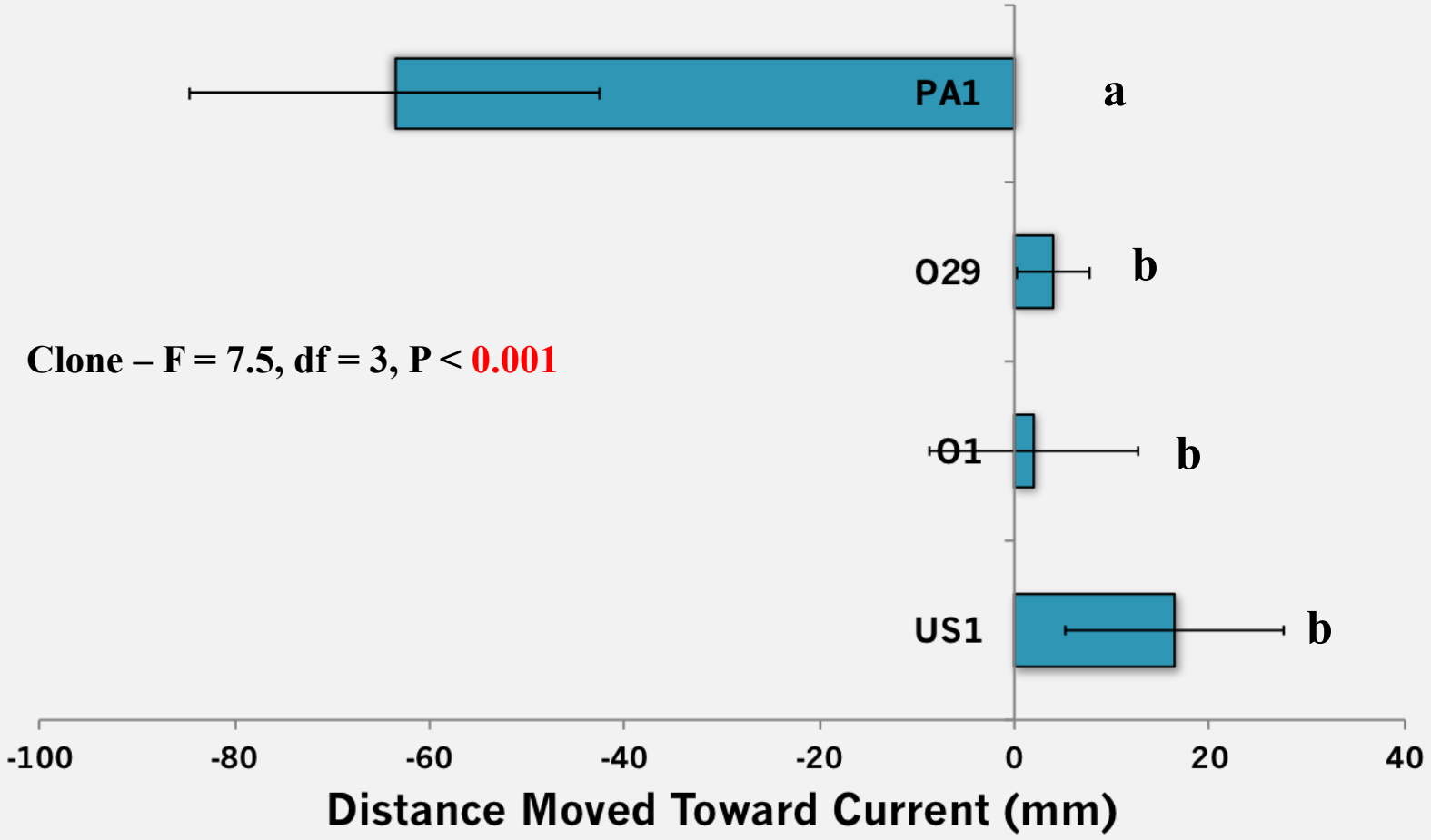

27°
Average Number of Snails Surviving
10
9
8
7
6
5
4
3
2
1
0
0
10
20
30
Days Wrapped
US1-PA
US1-NJ
US2-Syr
US1-MD

Growth and Fish Odor

Population – F = 22.0, df = 3, **P > 0.0001**
Treatment – F = 6.33, df = 1, **P = 0.013**
Pop x Trtmt - F = 1.43, df = 3, P = 0.234

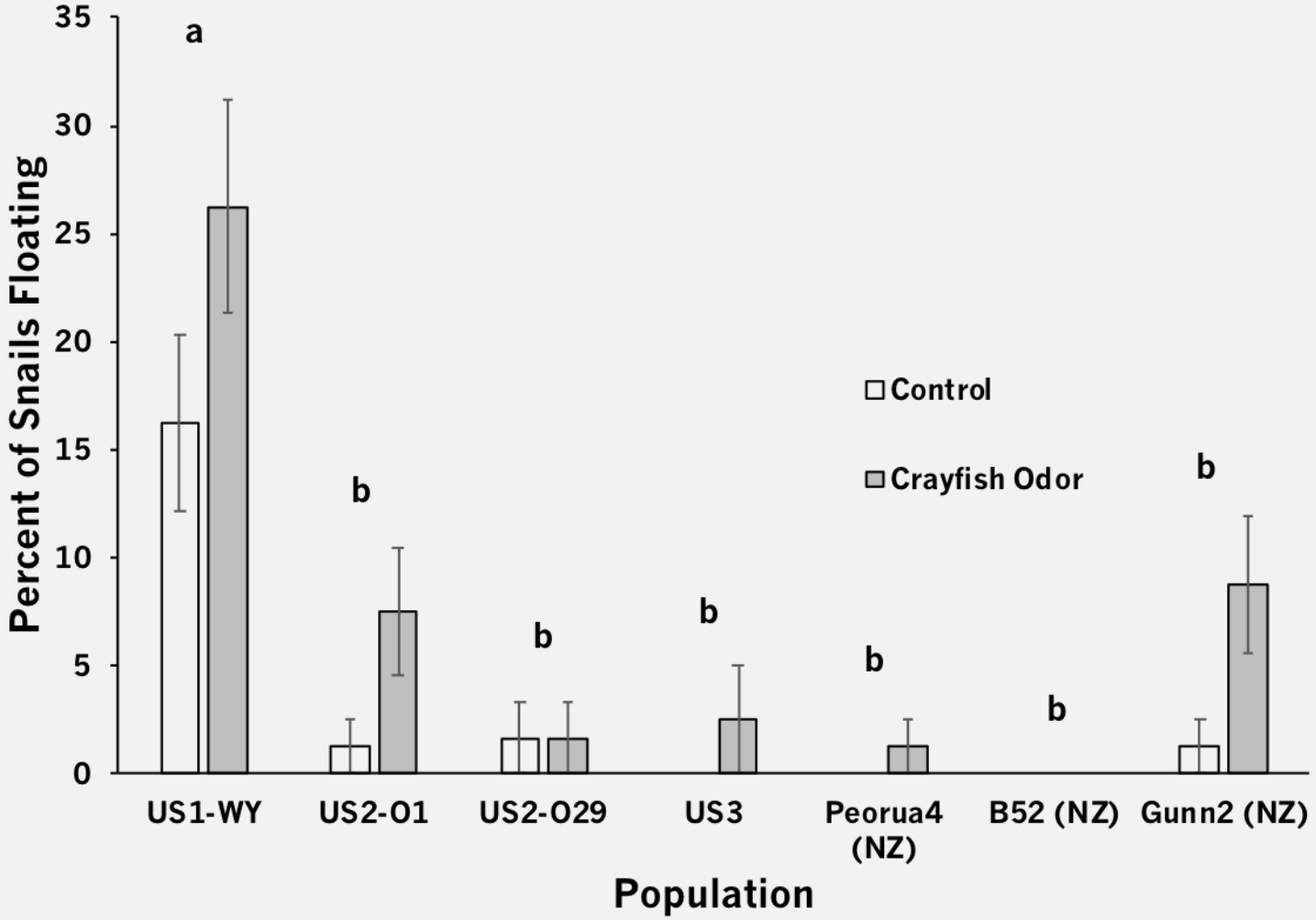


RHEOTAXIS RESULTS



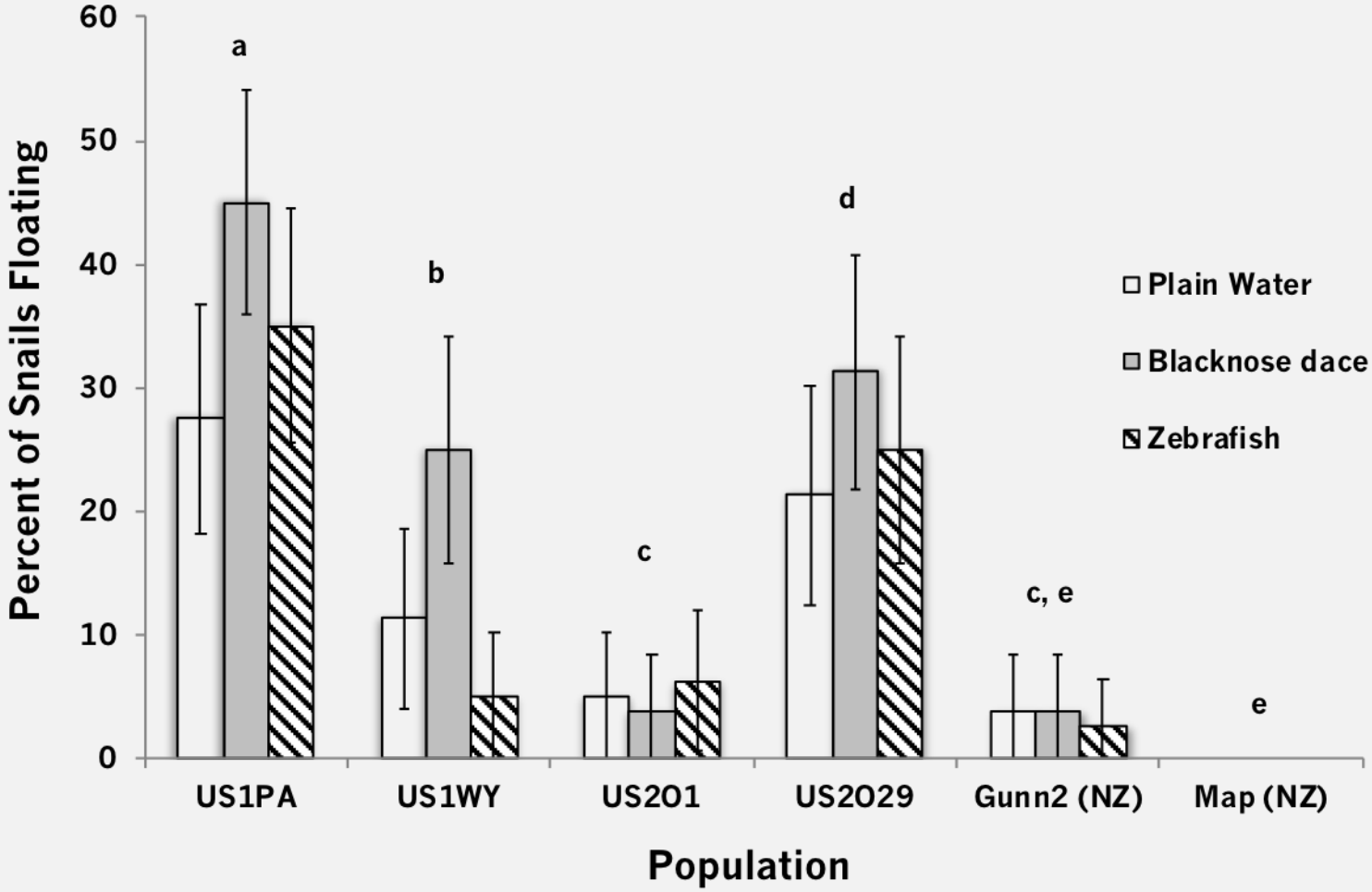
Clone – F = 7.5, df = 3, P < 0.001

Dispersal response to Crayfish



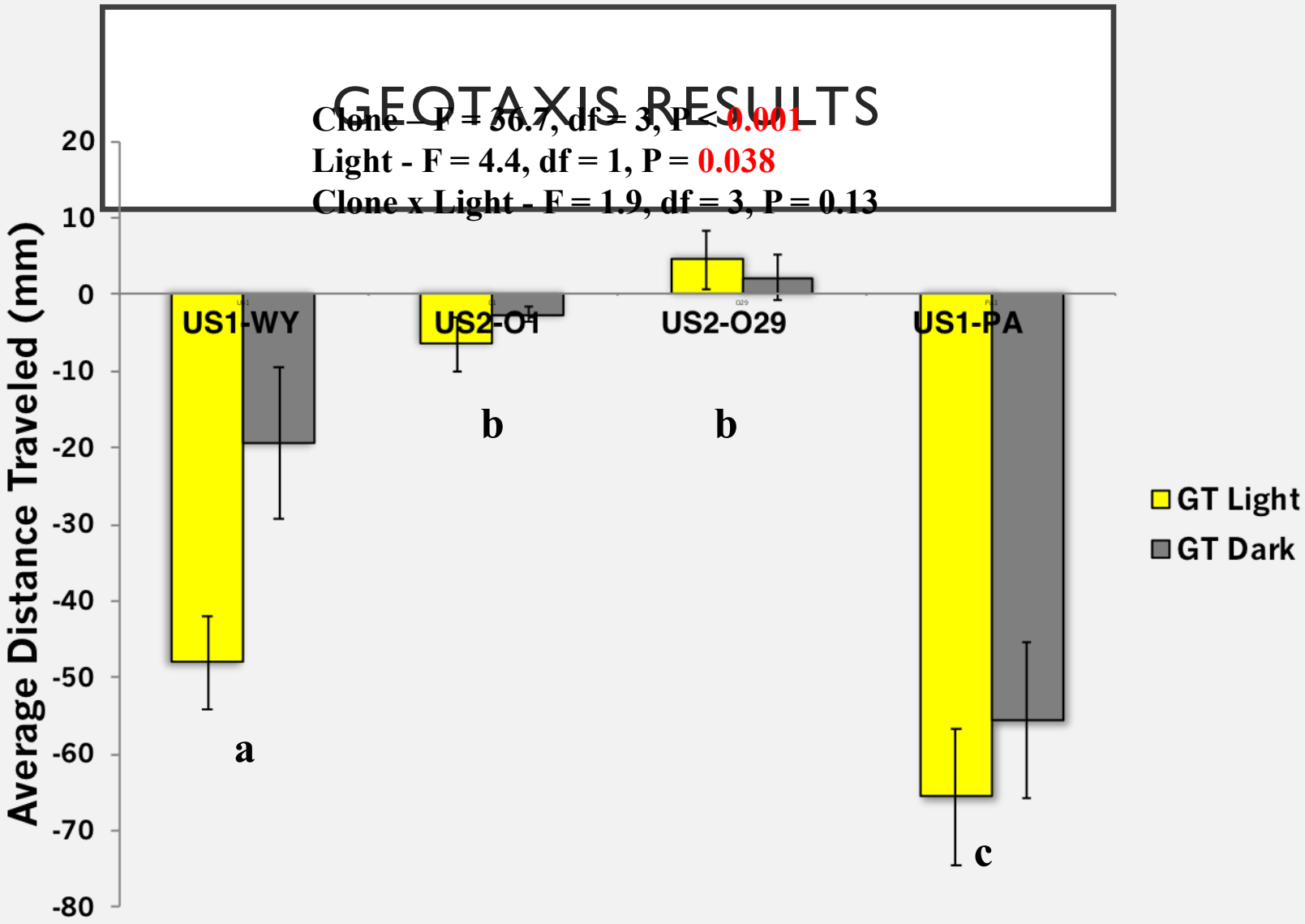
Levri et al. 2019 Aquatic Invasions.

Dispersal response to Fish



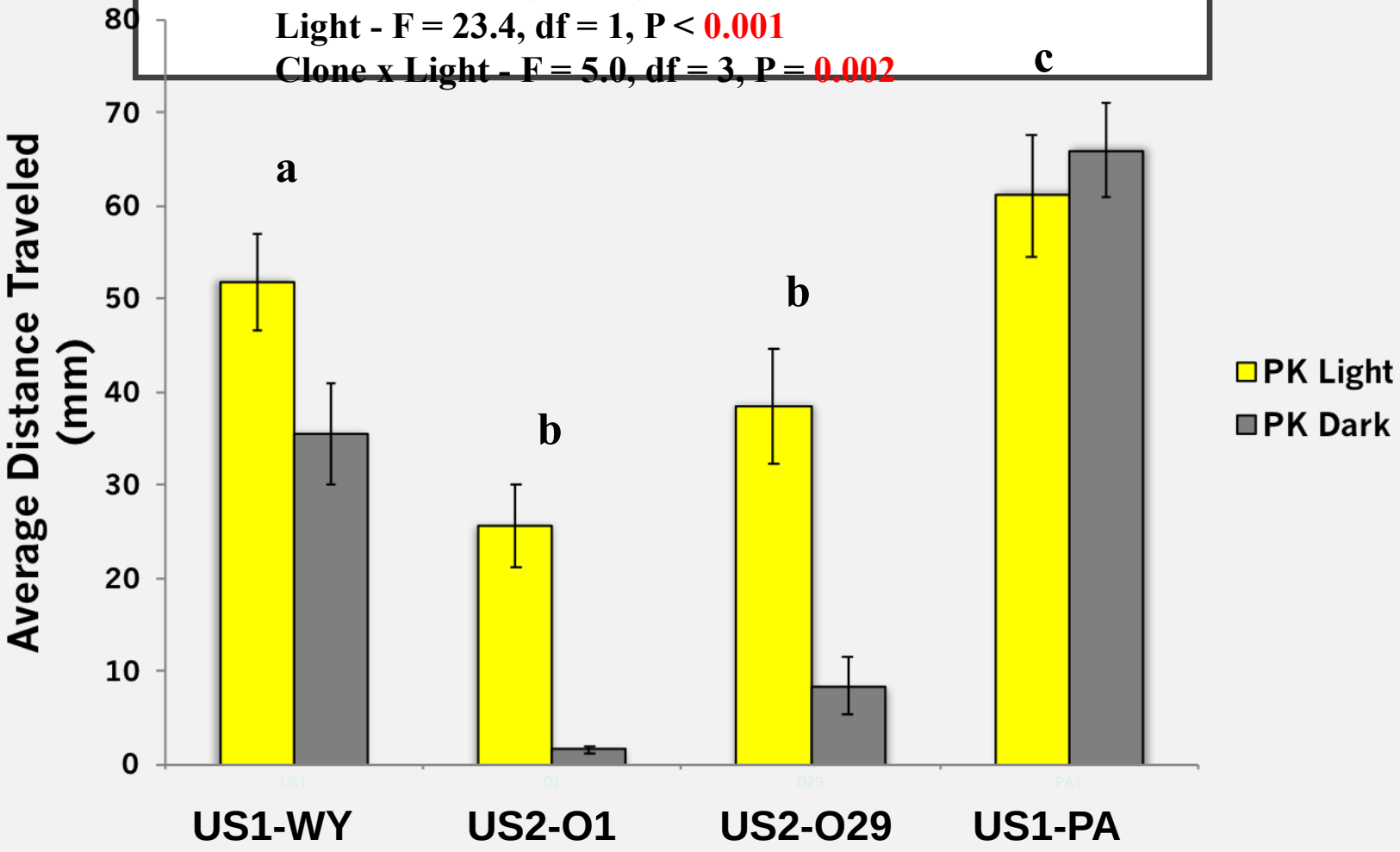
Levri et al. 2019 Aquatic Invasions.

GEOTAXIS RESULTS



PHOTOKINESIS RESULTS

Clone – F = 43.3, df = 3, P < 0.001
Light - F = 23.4, df = 1, P < 0.001
Clone x Light - F = 5.0, df = 3, P = 0.002



RHEOTAXIS EXPERIMENTAL SET-UP