Duckweed was used to study genetic and morphological change

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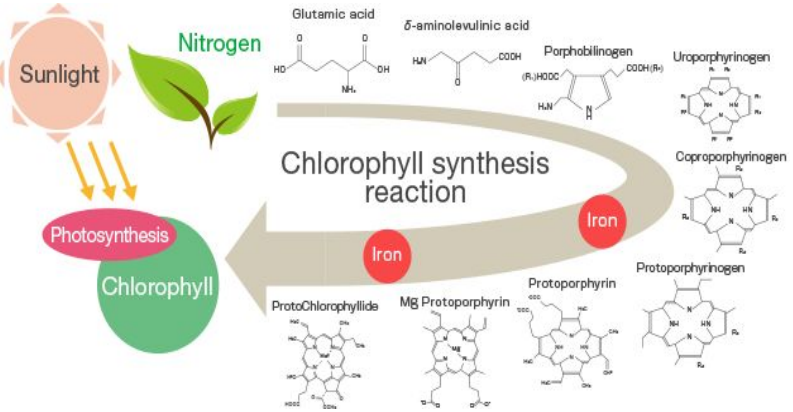
Changes in the environment affects the biodiversity of populations.

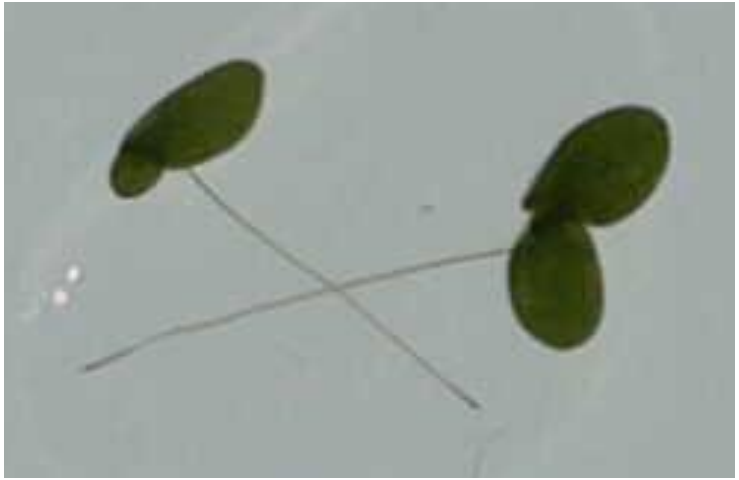
Iron Chloride in ponds can impede morphological and physiological functions in Duckweed Species.

Color chan
in Duckwe
Fronds

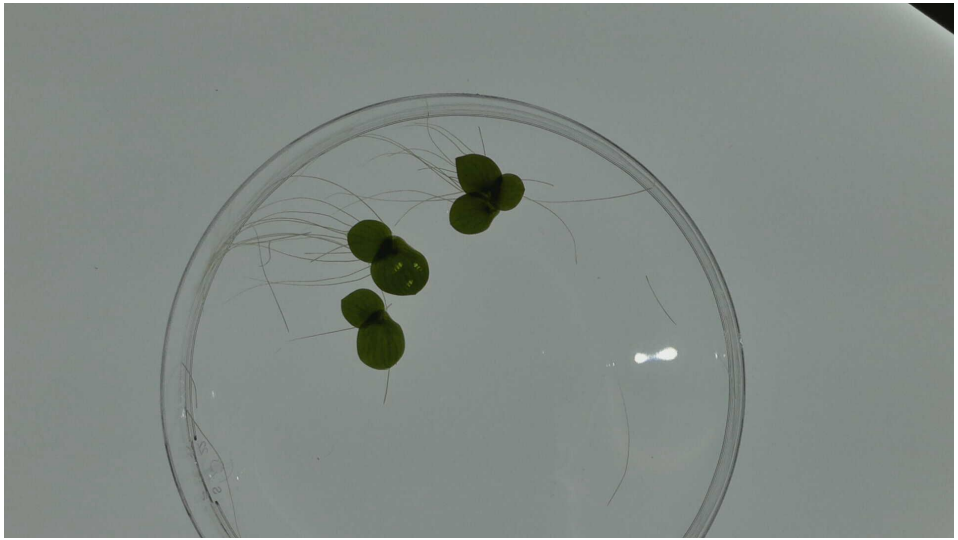


Inhibition of Metabolic processes

Morphological differences in Lemna minor and Spirodela polyrhiza are valuable for observing growth in polluted conditions.



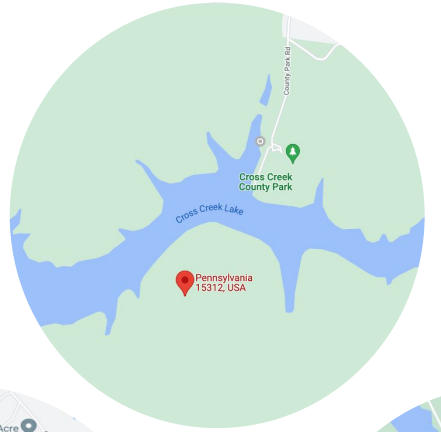
Lemna minor
1 root
Shape: Teardrop



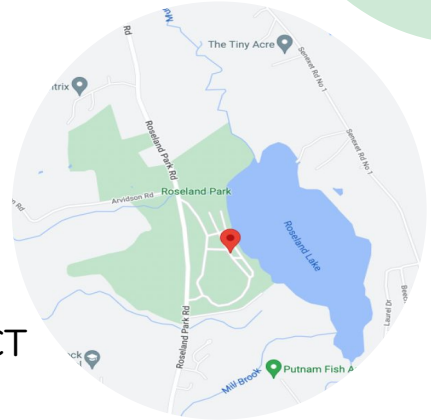
Spirodela polyrhiza
Multiple Roots (Approx. 5 - 6)
Shape: Oval/Round

Duckweed clones were collected from pond sites in varied geographic regions.

S. polyrhiza
SP00003 Cross Creek Lake, PA



L. minor
MI-MLSG5 LM3
Otter Lake, MI

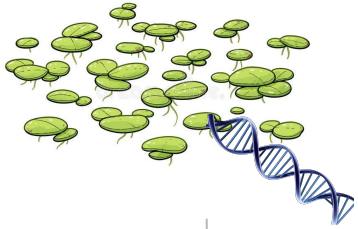


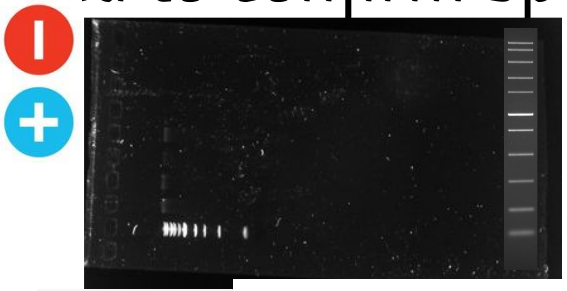
S. polyrhiza
CT-CRLP SP56
Roseland Lake, CT

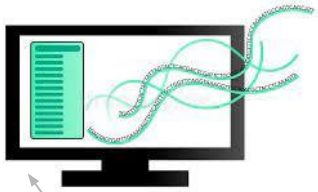
L. minor
WI-NIN LM66
Cumberland Lake, WI

Through development of a genetic barcode, an observational study was conducted to distinguish the identity of the duckweed.

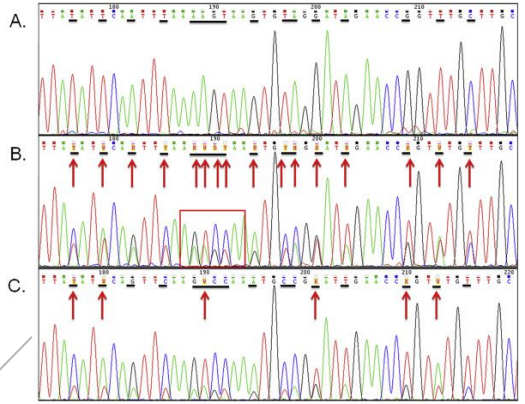
Using various primers, PCR and DNA sequencing were conducted to confirm species identity.







BLAST

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***:**********:************** ******:**** **.**********:* **
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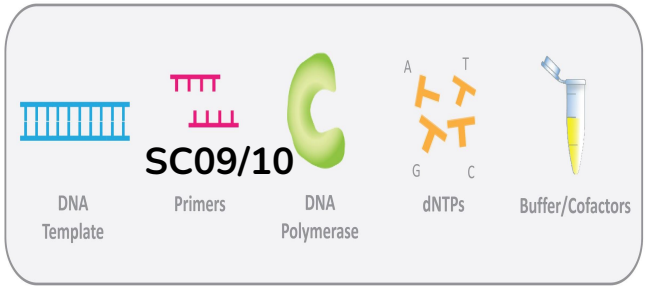
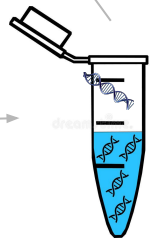


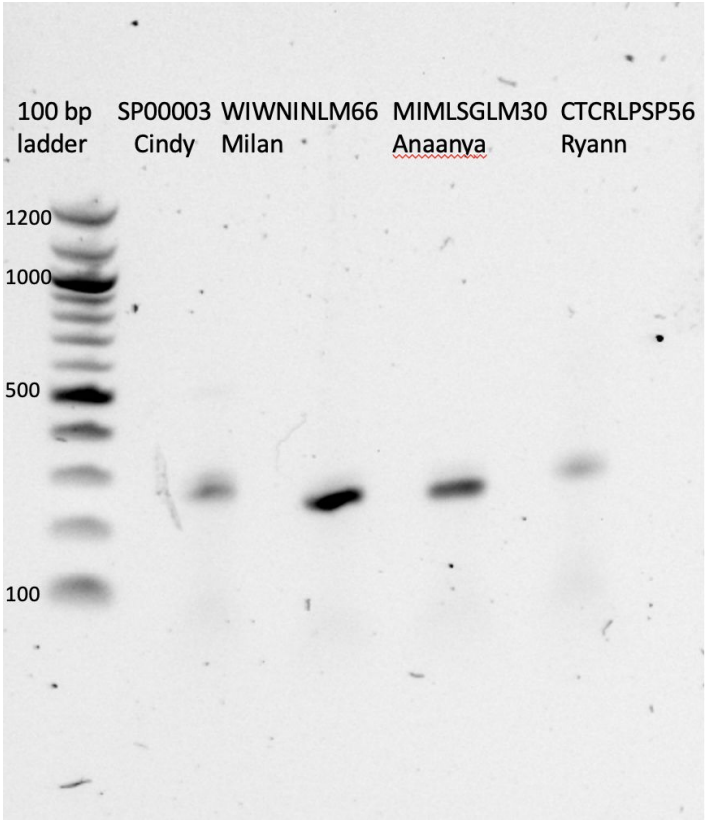


1. TACCGCTTTCCCGCTAACTCAGGCATT
2. TACGAATCTATGCAAGCCTAAAAAATC
3. TACTAACTTAGGGCAACACAACGTATT
4. TACTGAAGGCATAACCAGGAGCACACT

MUSCLE

Query + E-value

The genetic material of 4 different clones of duckweed were amplified using PCR and the SC09/10 primer.



Each clone was positively identified using DNA sequencing of particular barcodes in their genomes.

Clone ID	SP3 (SP00003)	LM66 (WIWNINLM66)	LM30 (MIMLSGLM30)	SP56 (CTCRLPSP56)
Species ID	*Spirodela polyrhiza*	*Lemna minor*	*Lemna minor*	*Spirodela polyrhiza*
Useful primers for barcodes	matK rbcL	matK	SC09/10	matK rbcL
Expected product size	matK: 862bp rbcL: 580bp	862bp	170-256bp	matK: 862bp rbcL: 580bp

SC09/10 F primer revealed distinct SNPs between *L. minor* and *S. polyrhiza* barcode sequences.

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CLUSTAL multiple sequence alignment by MUSCLE (3.8)


CTCRLPSP56      TAAATAAAATAAAAAATATATATATATATAGGATAATCCTGTAATTCTTTCCGGTATTCT
CTCACRSP73      TAAATAAAATAAAAAATATATATATATATAGGATAATCCTGTAATTCTTTCCGGTATTCT
SP00003         TAAATAAAATAAAAAATATATATATATATAGGATAATCCTGTAATTCTTTCCGGTATTCT
WIWSXTSP71      TAAATAAAATAAAAAATATATATATATATAGGATAATCCTGTAATTCTTTCCGGTATTCT
MIMsDRSLM31     -------------GAAAATATCTATAGATGGGGTAATTCTGTAATTCTTTACGGTATTCT
WIWNINLM66      -------------GAAAATATCTATAGATGGGGTAATTCTGTAATTCTTTACGGTATTCT
MIMLSG5LM30     -------------GAAAATATCTATAGATGGGGTAATTCTGTAATTCTTTACGGTATTCT
MIMR13LM41      -------------GAAAATATCTATAGATGGGGTAATTCTGTAATTCTTTACGGTATTCT
                             ** **** **** ** ** **** ************ *********

CTCRLPSP56      AATATTGAATACGTGTAGATATAGAATAAAATTTAAATTCATTGATCATTACATATAATT
CTCACRSP73      AATATTGAATACGTGTAGATATAGAATAAAATTTAAATTCATTGATCATTACATATAATT
SP00003         AATATTGAATACGTGTAGATATAGAATAAAATTTAAATTCATTGATCATTACATATAATT
WIWSXTSP71      AATATTGAATACGTGTAGATATAGAATAAAATTTAAATTCATTGATCATTACATATAATT
MIMsDRSLM31     AGTATTCAATATCTGTAGATCTAAAATAAAATGTAAATTCATTGATCATTACATAGAATT
WIWNINLM66      AGTATTCAATATCTGTAGATCTAAAATAAAATGTAAATTCATTGATCATTACATAGAATT
MIMLSG5LM30     AGTATTCAATATCTGTAGATCTAAAATAAAATGTAAATTCATTGATCATTACATAGAATT
MIMR13LM41      AGTATTCAATATCTGTAGATCTAAAATAAAATGTAAATTCATTGATCATTACATAGAATT
                * **** ****  ******* ** ******** ********************** ****

CTCRLPSP56      CAATTAAGATATTGTATGAAAGTATAATTCCTTGTATTCTCATTTGAAAATGTAAGGATT
CTCACRSP73      CAATTAAGATATTGTATGAAAGTATAATTCCTTGTATTCTCATTTGAAAATGTAAGGATT
SP00003         CAATTAAGATATTGTATGAAAGTATAATTCCTTGTATTCTCATTTGAAAATGTAAGGATT
WIWSXTSP71      CAATTAAGATATTGTATGAAAGTATAATTCCTTGTATTCTCATTTGAAAATGTAAGGATT
MIMsDRSLM31     CAATTAAGATATTGTATGAAAGTATAATTCCTTGTATTCTCATTTGAAAATGTAAGGATT
WIWNINLM66      CAATTAAGATATTGTATGAAAGTATAATTCCTTGTATTCTCATTTGAAAATGTAAGGATT
MIMLSG5LM30     CAATTAAGATATTGTATGAAAGTATAATTCCTTGTATTCTCATTTGAAAATGTAAGGATT
MIMR13LM41      CAATTAAGATATTGTATGAAAGTATAATTCCTTGTATTCTCATTTGAAAATGTAAGGATT
                ************************************************************

CTCRLPSP56      TTTGATTTGGATTTTTTGGGGGAGTTCAAATCAAAGAAA-
CTCACRSP73      TTTGATTTGGATTTTTTGGGGGAGTTCAAATCAAAGAAA-
SP00003         TTTGATTTGGATTTTTTGGGGGAGTTCAAATCAAAAAAAA
WIWSXTSP71      TTTGATTTGGATTTTTTGGGGGAGTTCA------------
MIMsDRSLM31     TTTGATTTGGATTTTTTGGGGGAGTTCA-NTCAAAGA---
WIWNINLM66      TTTGATTTGGATTTTTTGGGGGAGTTCAAATCAAAGAAA-
MIMLSG5LM30     TTTGATTTGGATTTTTTGGGGGAGTTCAAATCAAAG----
MIMR13LM41      TTTGATTTGGATTTTTTGGGGGAGTTCAAATCAAAGAA--
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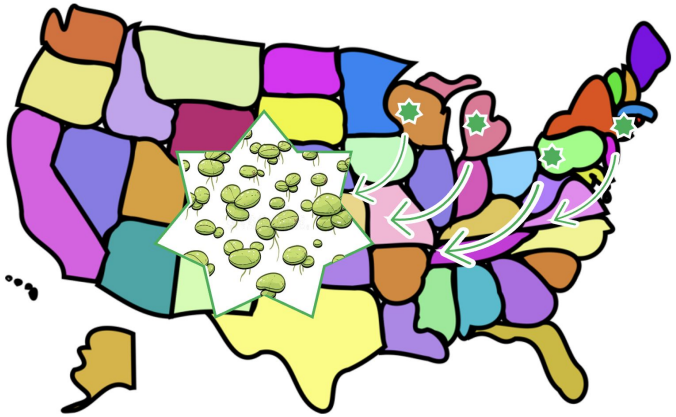
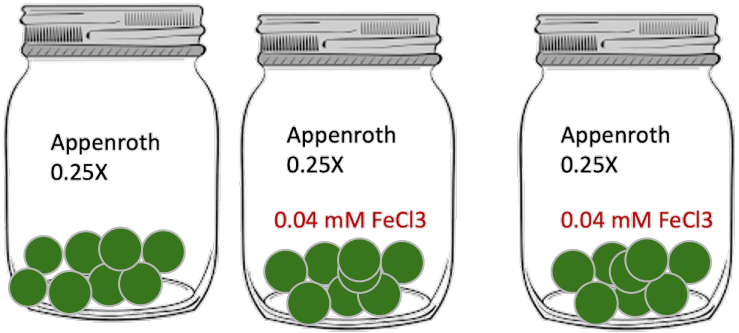
First 4 populations are *S. polyrhiza* and the following 4 are *L. minor*

What are the Physical Characteristics that we can Observe in the Jars of Duckweed with the Pollutants present?

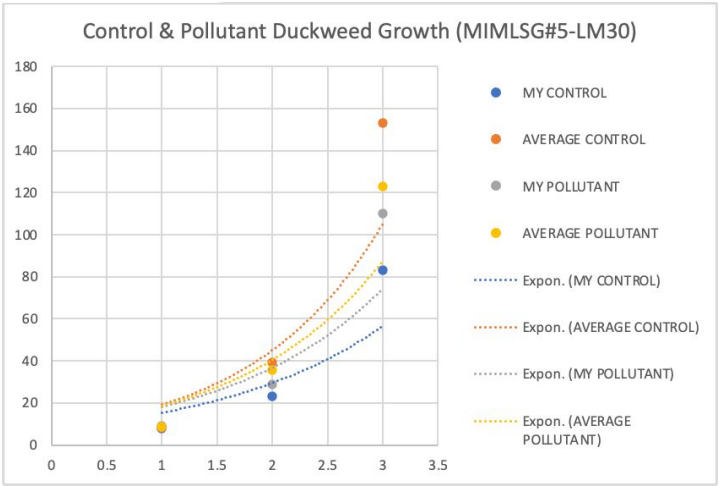
The collected duckweed was observed in an FeCl3 solution.



1. Collect Duckweed from various regions



2. Add 8 fronds to a control jar and 2 pollutant jars



3. Using Fiji, count the number of fronds, and use that number to synthesize results.

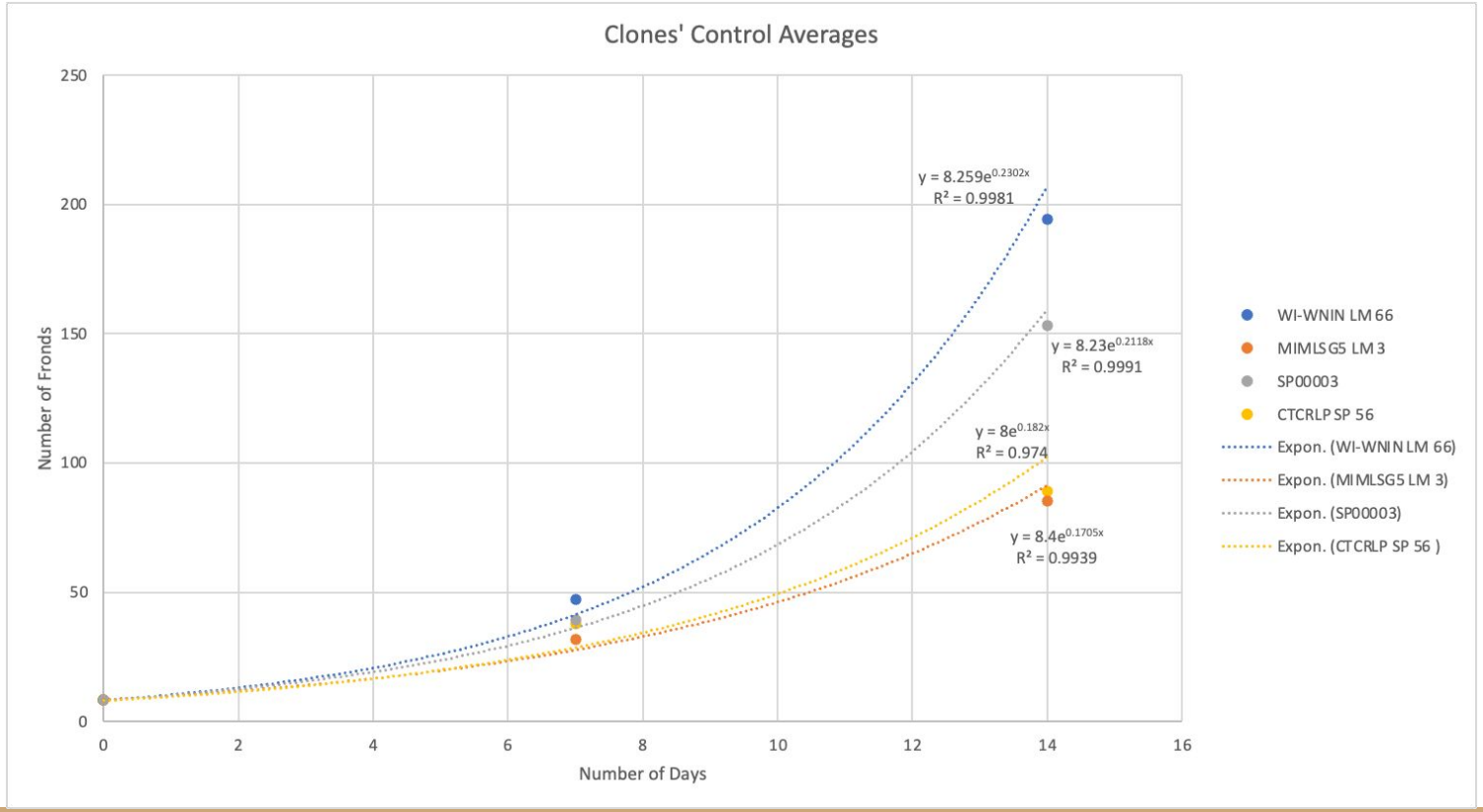
The growth of *S. polyrhiza* and *L. minor* clones were compared under controlled conditions.

S. Polyrhiza: (SP00003)

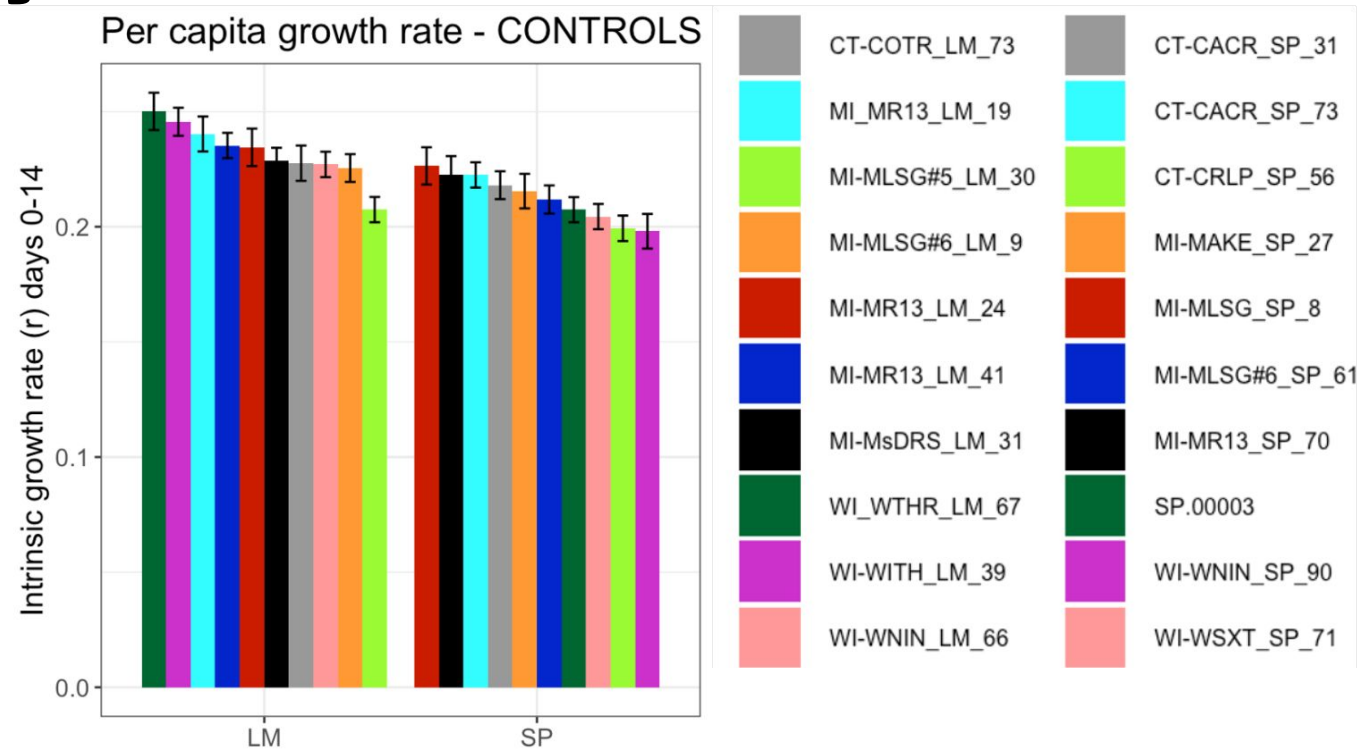
D0: → D7: → D14:

L. minor: (WI-WNIN LM 66)

Under controlled conditions, S. polyrhiza and L. minor clones followed an exponential growth trend.



Control Growth Rate Varied Between both Species and among Clones.



Bar Graph from Dr. Turcotte's Lab

14 days of exposure to the Iron contaminant negatively affected the growth of Lemna minor clones.

L. minor control (WI-WNIN LM 66)

L. minor FeCl3 pollutant (MI-MLSG#5 LM 30)

L. minor FeCl3 pollutant (WI-WNIN LM 66)

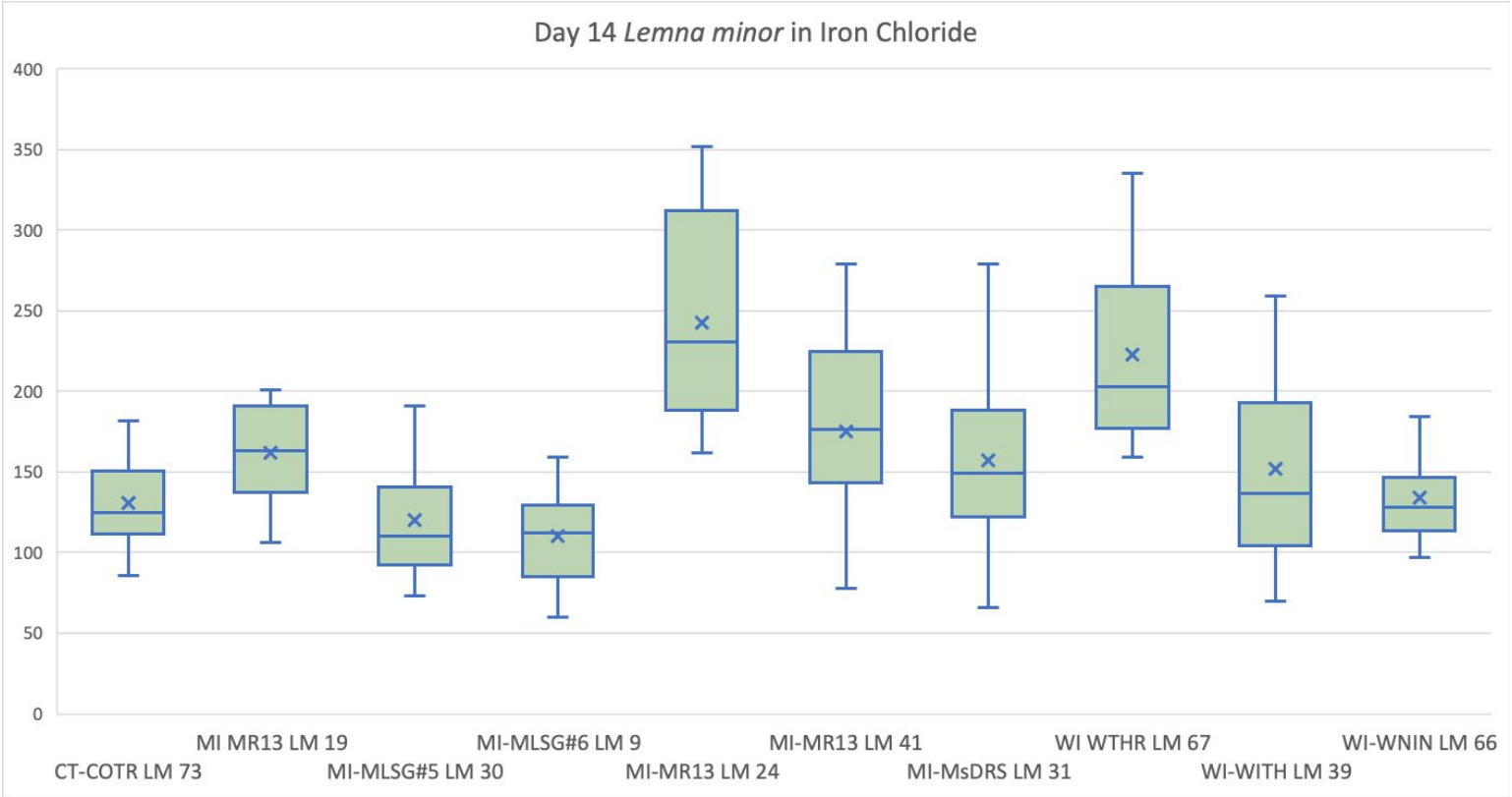
14 days of exposure to the Iron contaminant negatively affected the growth of *S. polyrhiza* clones.

S. polyrhiza Control (SP.00003)

Spirodela FeCl3 pollutant (SP.00003)

S. polyrhiza FeCl3 pollutant (CT-CRLP SP 56)

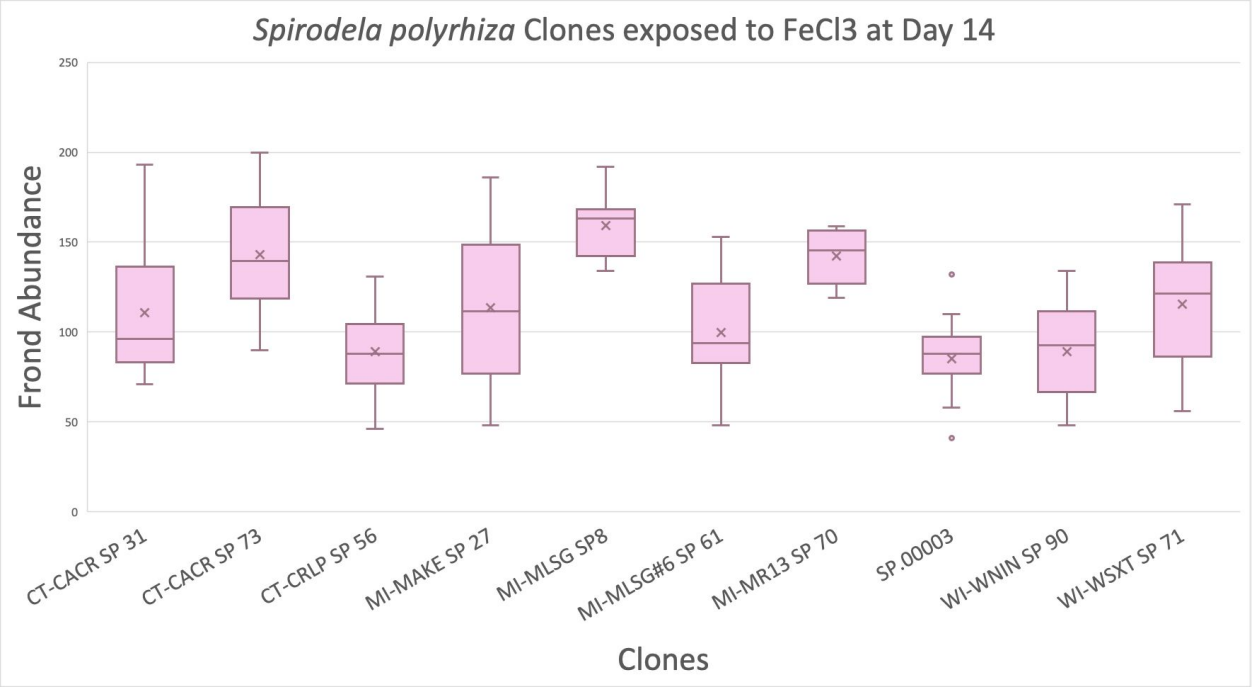
Lemna minor clones treated with FeCL3 caused variable frond abundance.



Average abundance of fronds in *L. minor* clones

Spirodela polyrhiza treated with FeCL3 caused variable frond abundance.

Average abundance between 10 clones of *Spirodela polyrhiza*



Conclusions

- Molecular conclusions: Genetic differences and the effectiveness of the SC09/10 primer

- Pollutant conclusions: Effect of $FeCl_3$ pollutant and clone tolerances

Future Directions

- Repetition
- Effectiveness of SC 09/10 primer on more species
- Concentration variations to study FeCl3 tolerance

Acknowledgements