# Citizen Science – Seriously

**Norman Yan**

Friends of the Muskoka Watershed

Science Driving Solutions

Friends of the Muskoka Watershed
Science Driving Solutions

- Vision:  Healthy Muskoka Watersheds Forever
- Our purposes, as of receipt of charitable status in 2022
  - To **protect the environment with projects** designed to:
    - **Preserve and protect** freshwater ecosystems and their watersheds
    - **Restore** lakes and rivers and their watersheds
    - And **improve watershed management**
  - To **increase public understanding** of freshwater ecosystems and their importance via public interactions and reviewing issues, and
  - To **conduct and disseminate the results of research** on freshwater ecosystems.

# Knowledge and Will

**Sources**:

The cardinal sources are

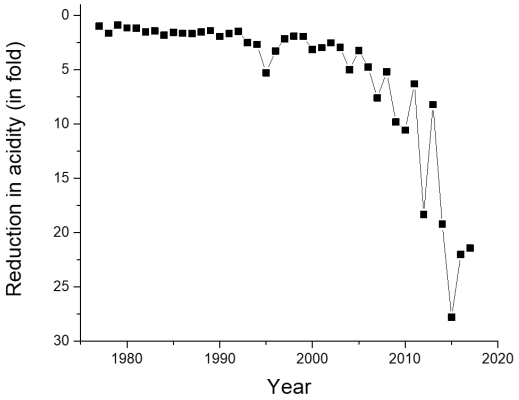
To solve environmental problems in a functioning democracy we need only

**Humility** → **Knowledge**

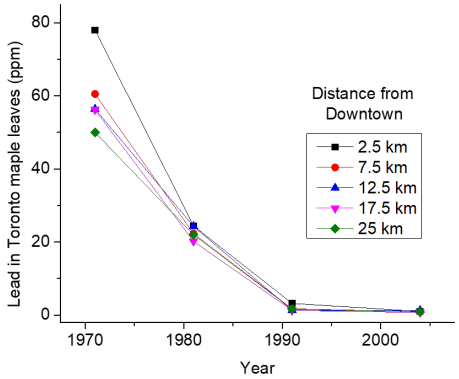
&

**Hope** → **Will**

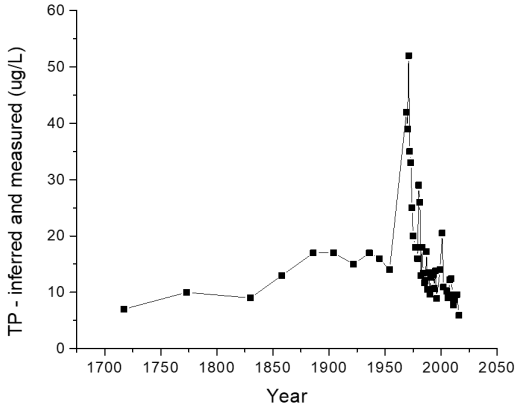
# Reasons for hope




Muskoka rain is 30* less acid




Pb in maple are 60-80* lower

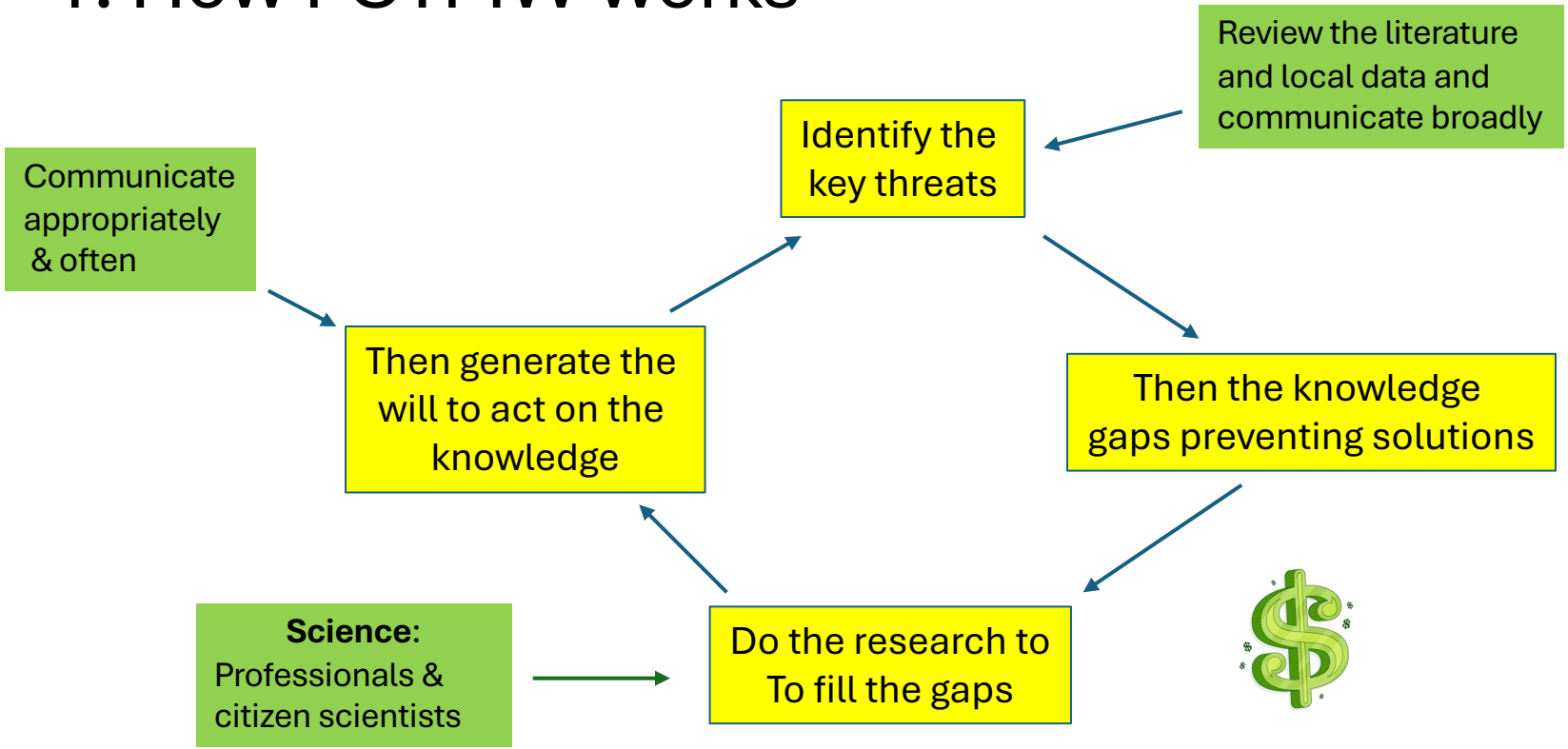



P is Muskoka Bay has recovered

# Objectives of the talk

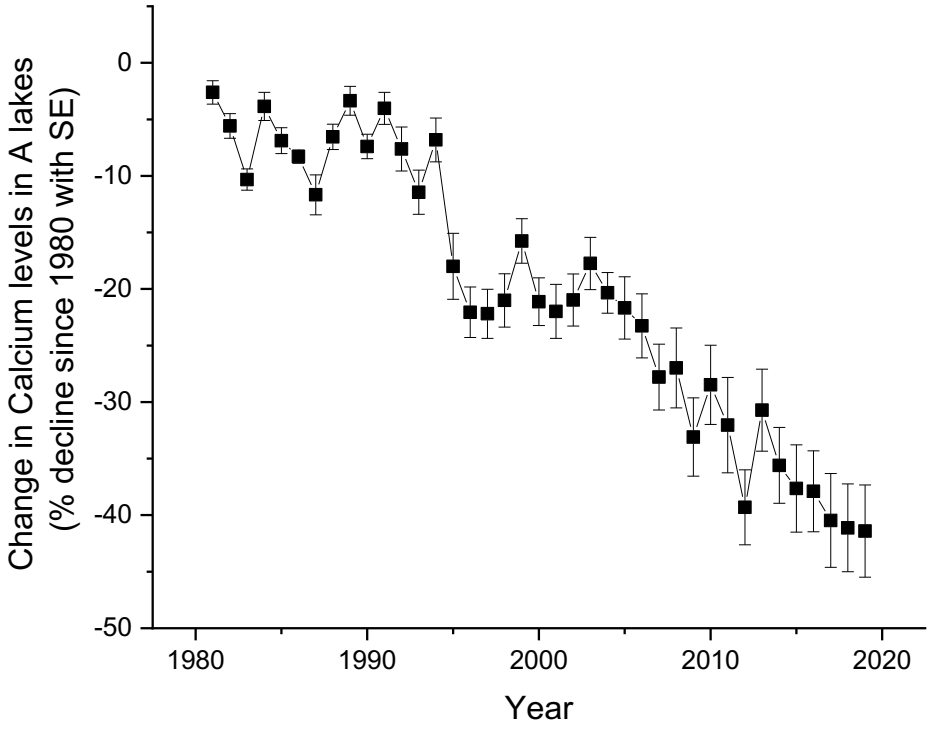
1. Present how FOTMW works.
2. Justify the issues we are tackling - calcium decline  and road salt
3. Explain the roles of citizen scientists
4. Summarize what we have learned about successful community engagement

# 1. How FOTMW works

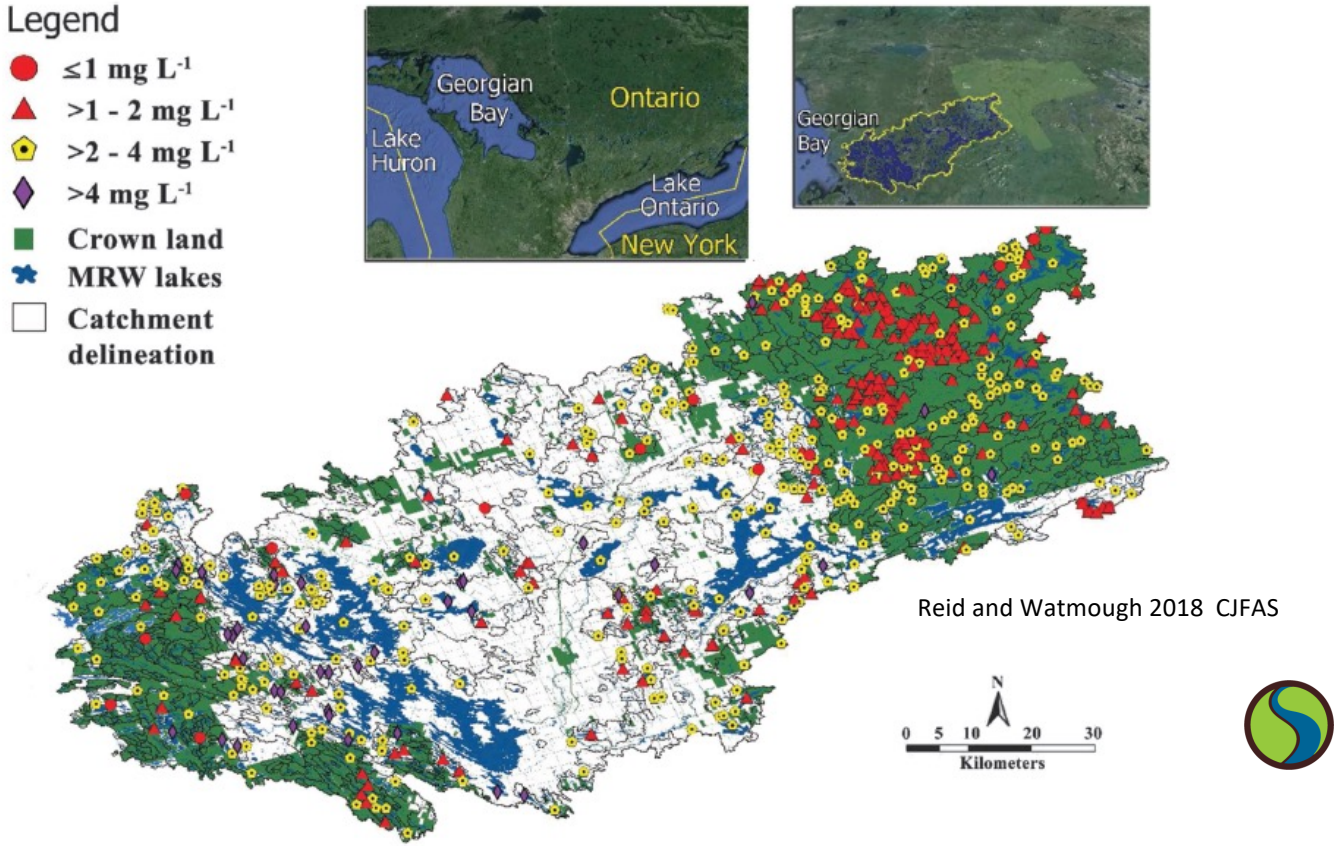


# 2: Why we chose calcium decline as the issue and firewood ash as a solution

Data from MECP's Dorset Env. Sci. Centre from 7 A lakes

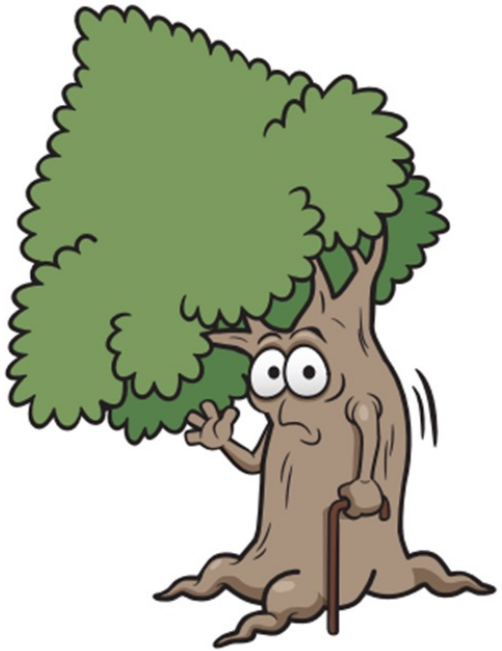


# ½ the lakes have problematically low Ca



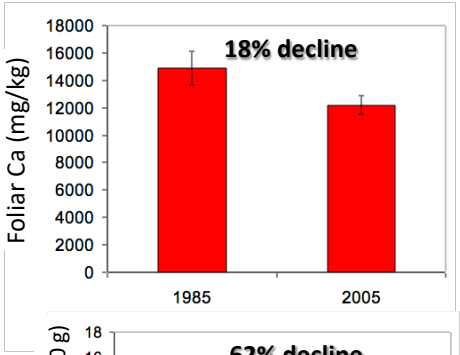

Reid and Watmough 2018 CJFAS

**We know animals like *Daphnia* and crayfish are suffering from Ca decline, but trees are also under stress**

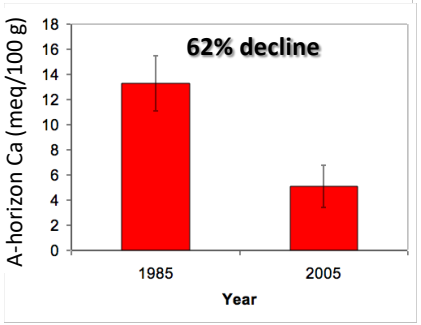


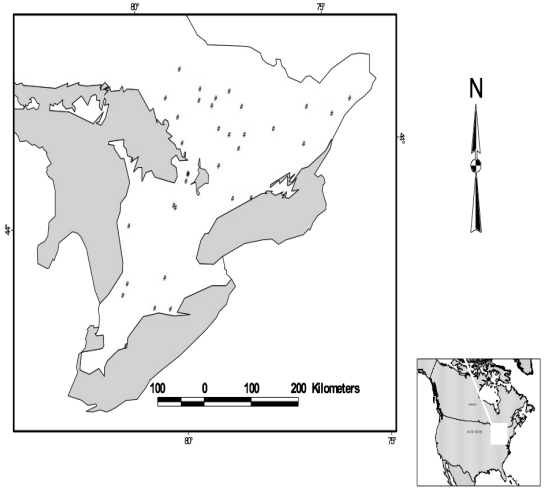
# Ca has fallen in soils and forests across S. Ont.

Sugar Maple leaves




Surface soil

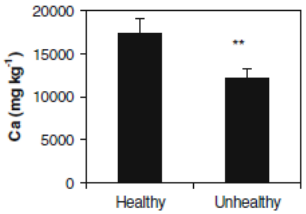



from Miller & Watmough 2009

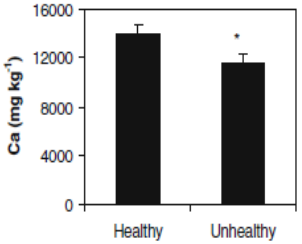
# And sugar maples suffer when soil & leaf Ca fall*

**Forest Floor Ca**




**Healthy DI <10, (n = 18)**
**Unhealthy DI>10 (n = 17)**

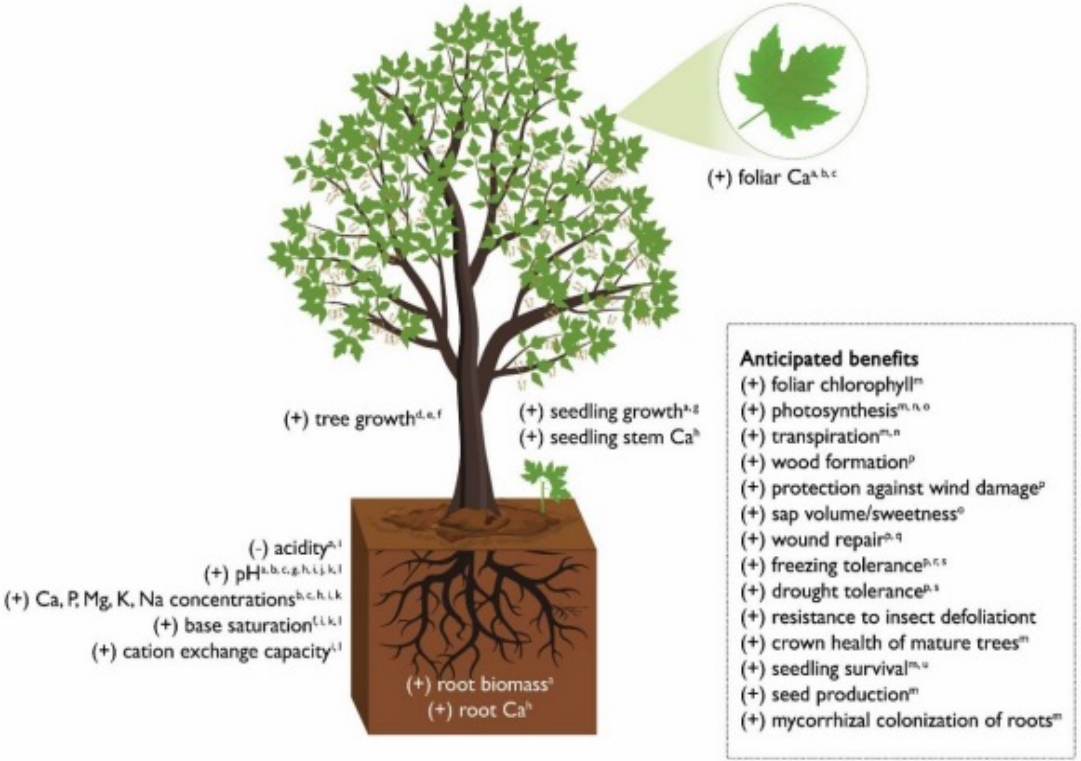
**Foliar Ca**




*Watmough 2010

The science behind adding Ca as a solution is strong (Kim et al 2022)

Dr. Natalie Kim



# Goals of ASH MUSKOKA

Friends of the Muskoka Watershed

- To encourage public engagement in environmental protection
- To develop Canada's first Non-Industrial Wood Ash collection and re-use program designed to solve the problem of calcium decline
- To learn how to do it:  the amounts of wood ash needed, prove it works, how to get it approved, how to get people involved

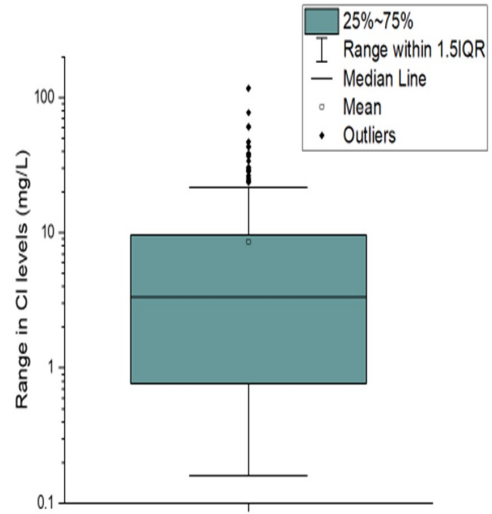

# 2. Why we chose road salt pollution as our 2nd issue

# Current Cl levels may be toxic in ¼ of Muskoka lakes

120 mg/L CWQG Cl

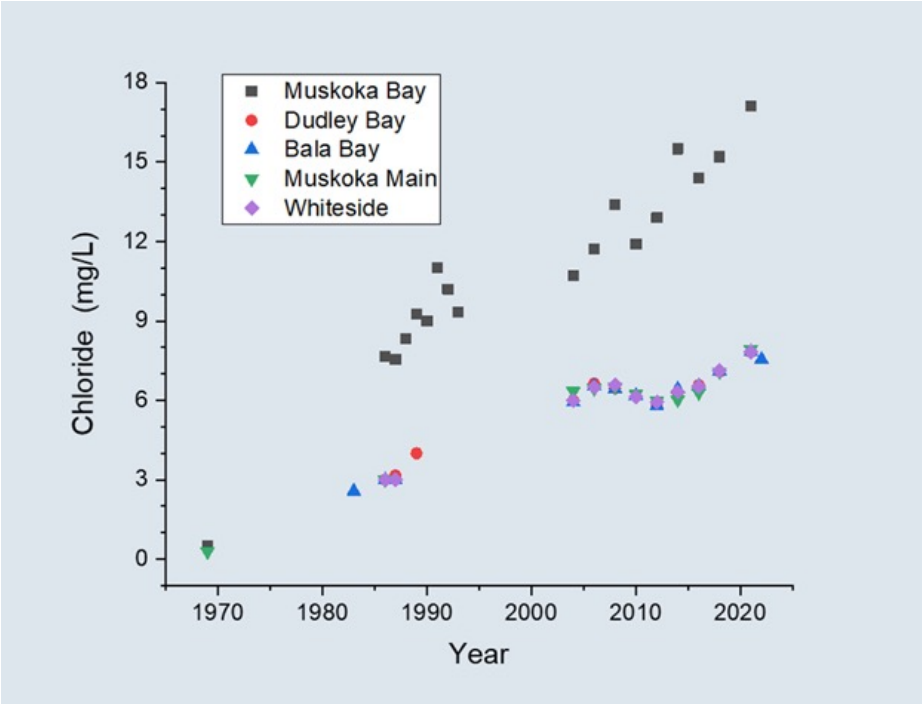
40 mg/L, Brown & Yan $LC_{50}$

~10 mg/L, Arnott et al. **$LC_{50}$**




Box plot of Cl levels in
160 Muskoka Lakes (DMM data)

# And levels are rising*, e.g. in Lake Muskoka




*MNR, MOE, MECP and DMM data

# Goals of SALTY MUSKOKA

Friends of the Muskoka Watershed

- To engage with students to reduce excessive salt use at schools and in communities
- To establish a SALTYCitizen network to track excessive uses of road salt
- To engage with lake associations to reduce excessive use of salt
- To engage with owner/operators of parking lots to reduce excessive use of salt and start a conversation about SMART ABOUT SALT certification
- To work with store owners to provide alternatives to salt
- To track changes in salt levels in streams feeding Lake Muskoka and Jevins Lake
- To engage and collaborate with indigenous peoples and youth on the issue

CS T&P

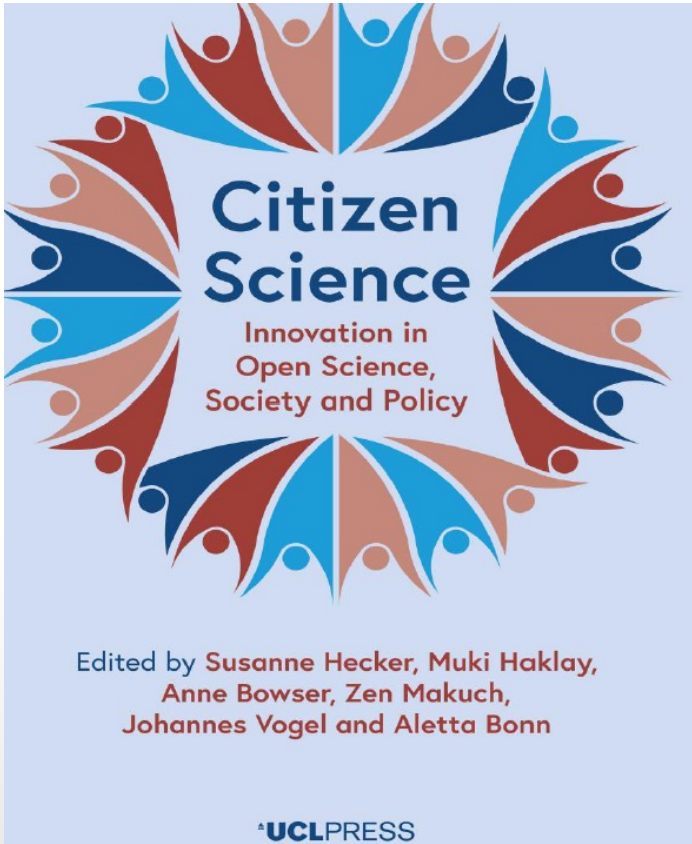
# CITIZEN SCIENCE:

## THEORY AND PRACTICE

Welcome to ECSA

We are the European Citizen Science Association

Association for Advancing Participatory Sciences



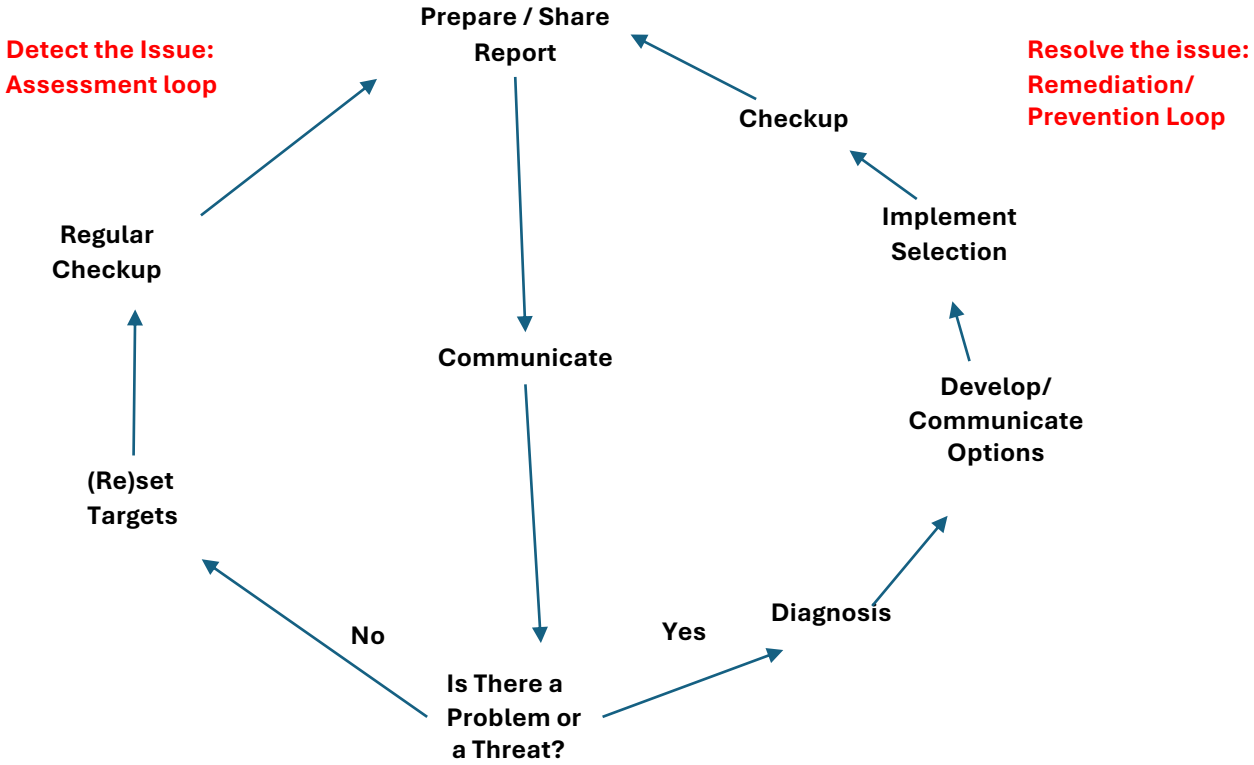
# Citizen science isn't just 'cheap labour'

Image from the Mancunion

# Principles of Citizen Science (ECSA)

- Citizen Science (CS) participants play meaningful roles and contribute to meaningful outcomes
- Both CS participants and professionals should benefit
- CS participants receive feedback
- CS can democratise the science
- CS data are made publicly available
- CS participants are acknowledged
- CS programs are evaluated for their output, participant experience and societal or policy impact
- Project leaders consider legal and ethical issues on IP, data sharing, insurance, etc.

# A plan for environmental management (MoReCo) framework*




*Dillon, Mierle, Somers & Yan, MOE, 1990
Cianci-Gaskill et al. 2024 Lake Resrvr Mngmnt

# Engaging with citizen scientists in ASHMuskoka

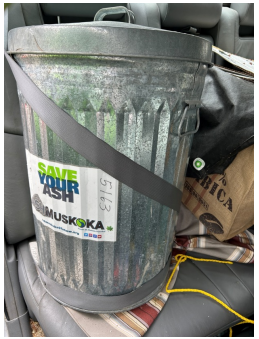

We thought firewood ash might be a solution to forest calcium decline, but there were knowledge gaps

- Is there enough ash with enough calcium?
- Will the public share that ash?
- How do we run a firewood ash collection program?
- Will the District support it?
- Will the MECP approve using ash as a forest soil amendment?
- How quickly will the calcium leach out of the ash?
- Do trees really benefit?  How quickly?
- Will maple sap chemistry be affected?
- Are there environmental risks?


ASHMUSKOKA
Friends of the Muskoka Watershed

# And it worked: 100s of local residents have contributed firewood ash

| year | ash collected (tonnes) | # of donations | unique donors |
|---|---|---|---|
| 2019 | 3.73 | 178 | 153 |
| 2020 | 8.85 | 324 | 245 |
| 2021 | 6.18 | 175 | 147 |
| 2022 | 8.11 | 255 | 198 |
| 2023 | 4.23 | 154 | 133 |
| 2024 | 5.53 | 172 | 159 |
| sum = | 36.64 | 1258 | 1035 |
| **average =** | **6.11** | **210** | **173** |




# Foliar nutrition improved dramatically after two years

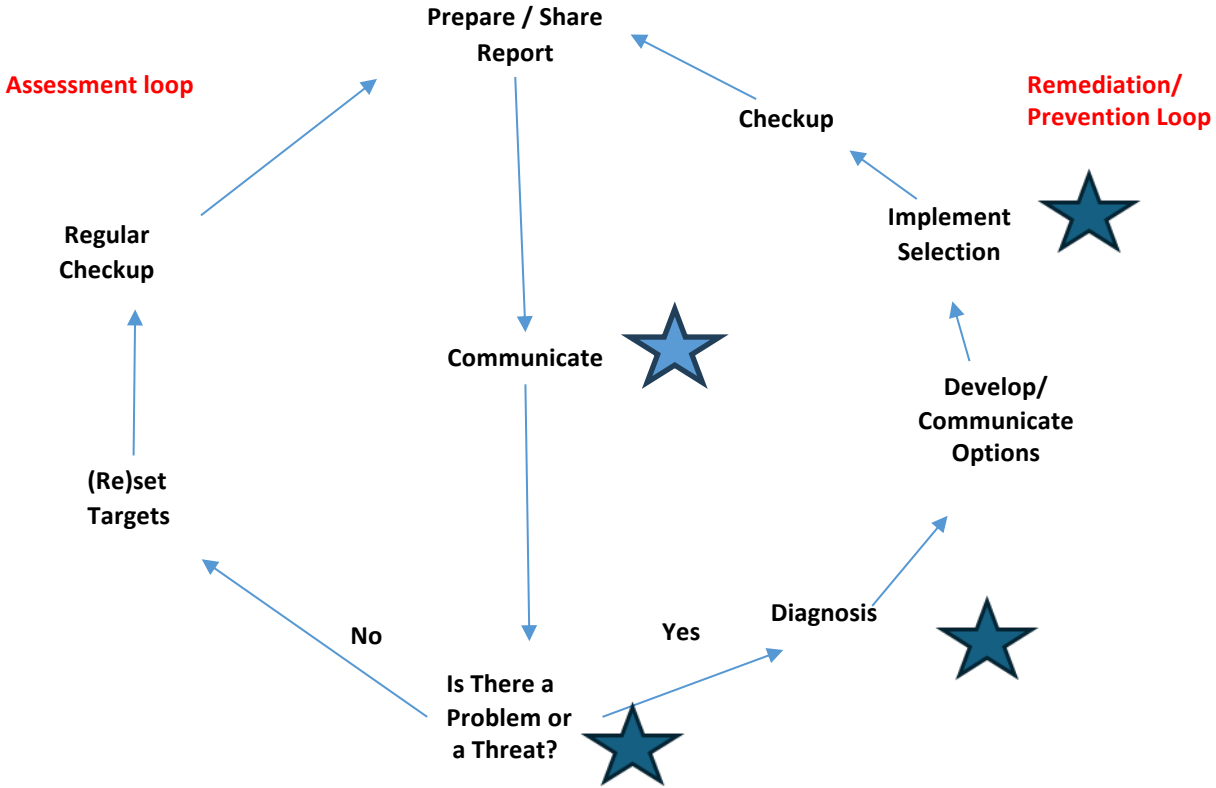
**% Difference in Foliar Nutrients of Ashed from Control Plots in 3 bushes 2 years after treatment (S. Conquer raw data)**

| | Mature Maple | | Maple Saplings | |
|---|---|---|---|---|
| | 4 t | 8 t | 4 t | 8 t |
| Ca | 14 | 22 | 7 | 20 |
| K | 61 | 77 | 44 | 55 |
| Mg | 54 | 78 | 42 | 81 |
| P | 56 | 60 | 19 | 27 |
| Fe | 51 | 53 | 33 | 36 |
| | | | | |
| Mn | 39 | 12 | -29 | -36 |

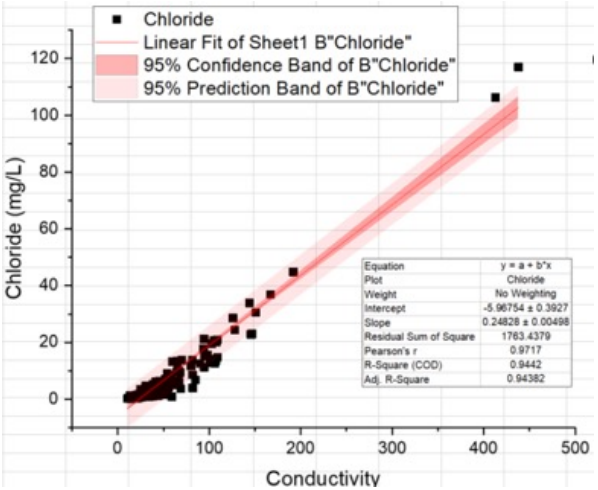
# In summary, we have learned

- There are many tons of ash produced annually
- The public will bring it to us, and governments will support the program
- The soil and trees benefit quickly from ash additions
- Maple sap chemistry does not change
- Metals in the ash are not an issue
- **1, 750 mL yogurt container of ash/sq metre is the needed dose, and you only have to add it once**
- Thanks to 100s of volunteers, and Trent students (Shelby Conquer & Batool Syeda) in the Watmough lab
- Dr. Watmough has continued the work

# Engaging with citizen scientists in SALTYMuskoka

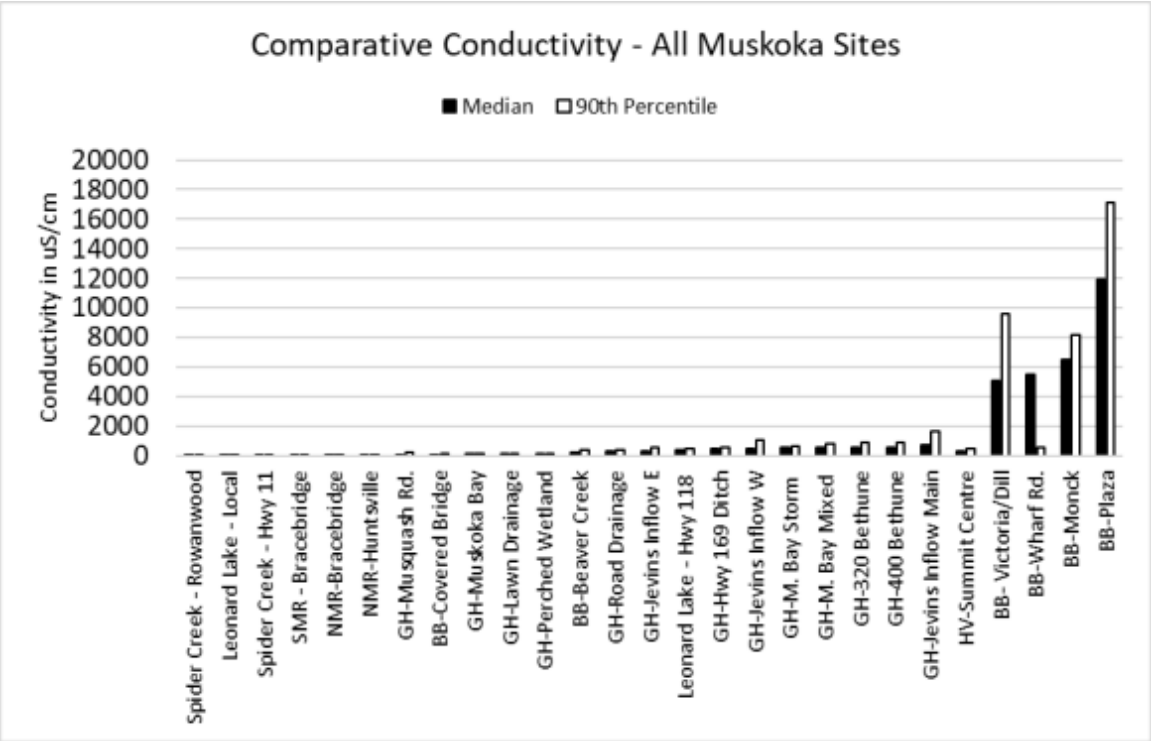


# A key knowledge gap is what land uses other than highway de-icing are the main chloride sources

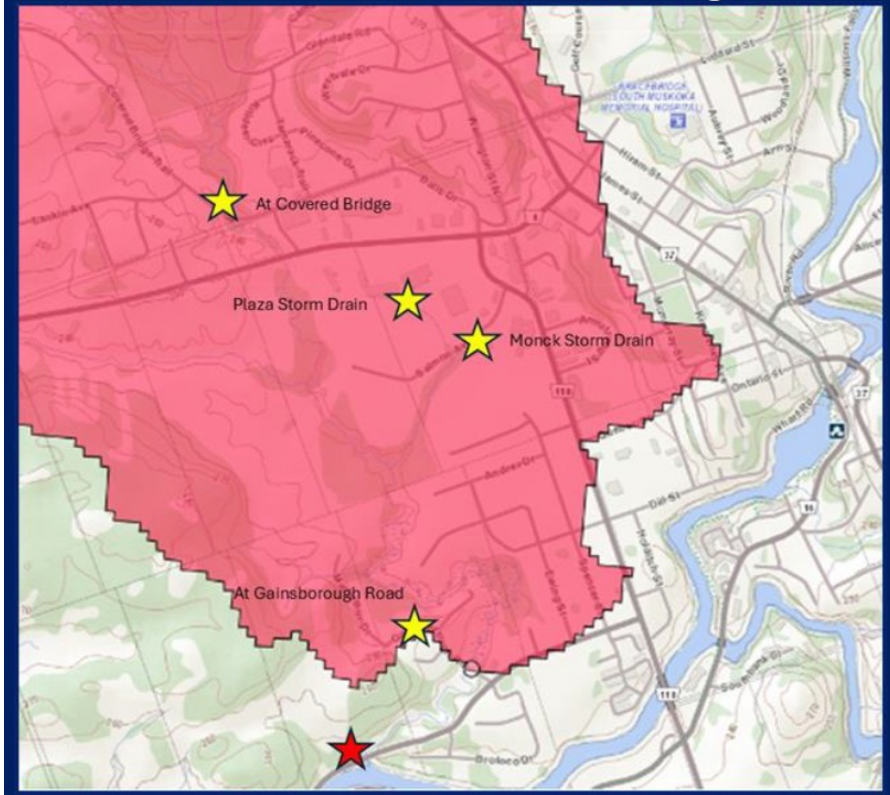



# citizen scientists recorded an enormous range in conductivity at 27 sites

(Hutchinson 2025)



# Beaver Creek Catchment – Bracebridge




# Beaver Creek Catchment – Bracebridge

High source areas
Doubled Cl concentrations in Beaver Creek
Candidate management sites

| | Beaver Creek at Covered Bridge | Beaver Creek at Gainsborough Bridge | Plaza Drainage | Monck Drainage |
|---|---|---|---|---|
| Minimum | 60 | 16 | 1070 | 820 |
| 10th Percentile | 74 | 68 | 1654 | 1594 |
| 25th Percentile | 78 | 116 | 5433 | 4433 |
| Median | 81 | 177 | 11905 | 6520 |
| 75th Percentile | 105 | 288 | 17155 | 7195 |
| 90th Percentile | 108 | 389 | 17155 | 8120 |
| Maximum | 111 | 540 | 19490 | 8180 |
| n= | 17 | 68 | 18 | 18 |

# 4. And what have we learned.

# Meet with the public and politicians early and often to:

- Test objectives
- Democratise them
- Test assumptions
- Assemble support
- Turn knowledge into action


# Working with watershed scientists isn't enough.

Shaun Watmough
School of Environ. Trent U
Several graduate projects
- required ash doses
- Risks & benefits for trees
- Availability of Ca in ash
- Maple sap production
- Forest fertilization policy

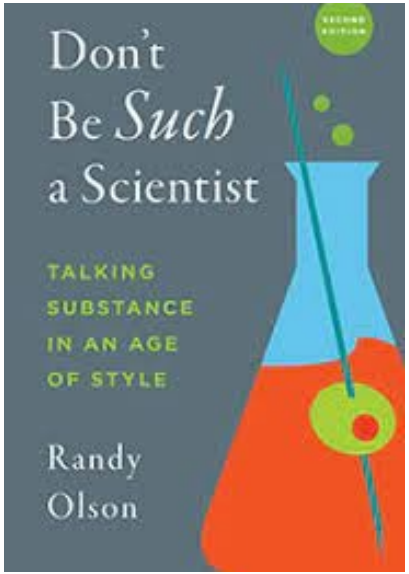
Bob Gifford
Environmental Psychology
U Victoria
PDF project on barriers
to public participation

Chantal Barriault
Science Communication
Laurentian U
Intern for ash addition video

Leila Scannell and Bob Gifford at U Victoria identified the following barriers to public participation in the ash project

- Changing my behaviour is not necessary
- I use my ash in other ways
- I don’t know enough to share my ash with you
- Sharing my ash is very inconvenient

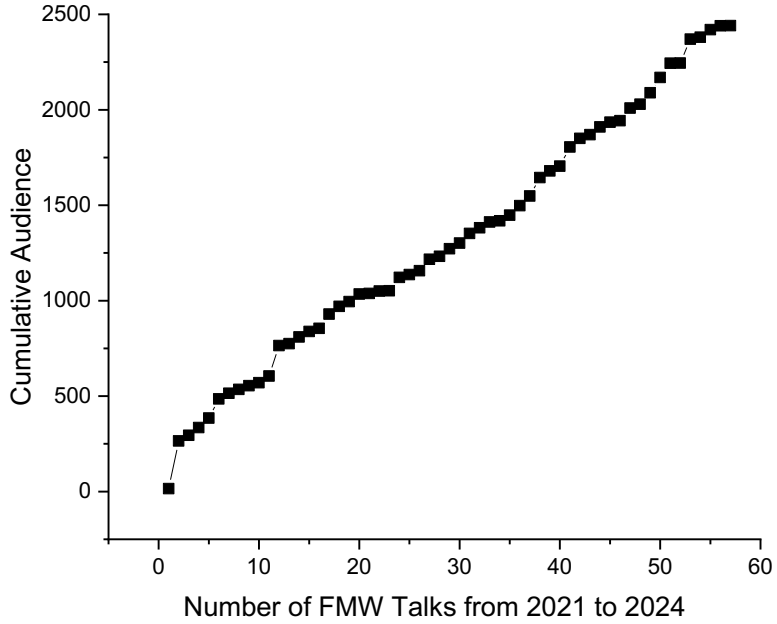
# You need to communicate differently - appealing to the heart and gut, not just the head



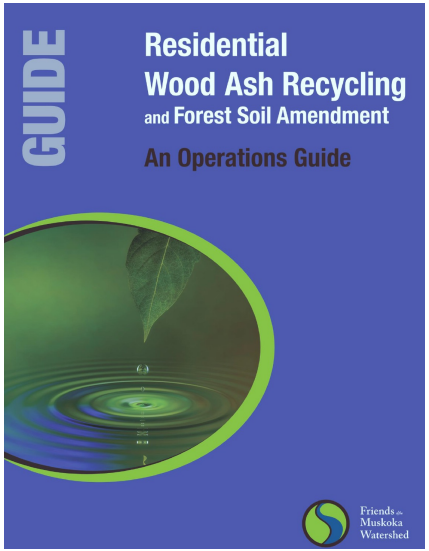

# Branding matters, and brands must be carefully crafted
# Being cheeky can work.



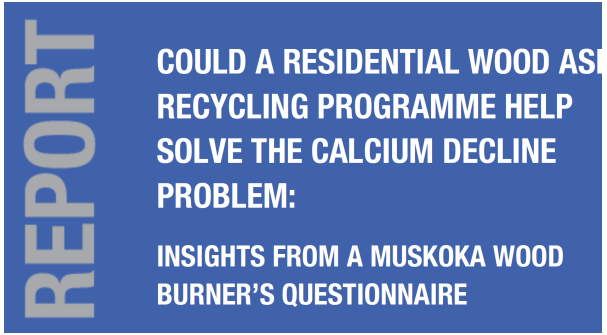
Share what you learn with many audiences



- **And report to the community, not just to other scientists**





**Simple communication is best.**
**How much ash is needed?**
**Just I yogurt container of ash per square metre.**

# Involve youth – here students from Rosseau Lake College adding ash at Camp Big Canoe on Earth Day

**let your CS colleagues lead in your communications with government.**
**Highlights of a DMM resolution carried Feb 19, 2025**
**Presented by our citizen scientists with FOTMW scientists for support**

Work to develop limited liability legislation with contractor training and develop best management practices for snow and ice management

Urge Ontario to create and fund an expert advisory committee charged to identify best approaches to protect fresh and drinking waters from salt

Reduce road salt use as much as safely possible, and report annual use

Communicate the resolution broadly

# Potential challenges of Citizen Science (MacPhail & Colla 2020)

# We have really benefited from working with citizen scientists

- **We've learned things we didn't know, and needed to know**
- **Our  goal setting has been democratised**
- **Our projects have received broad community support, and thus support from gov't.**
- **The scale of work we were able to do has been dramatically increased**
- **We've learned that CSs will participate in many phases of environmental protection if they deem the work to be  worthwhile**
- **Involving CSs hs sped the move from research to action**
- **Academics and their students have benefited enormously**
- **And it appears to have aided our charitable fundraising**

# To support Friends of the Muskoka Watershed (fotmw.org)


Friends of the MuskokaWatershed