



Maine Lakes...Living on the Edge?
**A physical science-social science
collaboration to evaluate lake
vulnerability and enhance lake
Stewardship**

The team

University of Maine – *Physicochemical*

Aria Amirbahman
Kaci Fitzgibbon
Steve Norton



University of Southern Maine – *Social Science*

Firooza Pavri
Emma Carey
Kari Beaulieu



The stakeholders

Department of Environmental Protection (DEP) – *Lake management*

Linda Bacon

Jeff Dennis, Jeremy Deeds



Maine Volunteer Lake Monitoring Program (VLMP) – *Citizen Scientists*

Scott Williams, Executive Director

Volunteers (~1,200)



Others – *Lake Stewards*

Lake Association Members

Shorefront Property Owners

Municipalities



The threats

- Atmospheric deposition (acid rain, Hg)
- Invasive species
- **Eutrophication - HABs**
 - Internal dynamics
 - Land Use
- **Climate change**
 - Extreme weather events
 - Warming
 - Reduced duration of ice cover
 - Longer growing season



Sabattus Pond 2014 Photo by Scott Williams

The urgency

- Climate change threatens Maine lakes
- Excess phosphorus in lakes is the leading cause of water quality decline
- 2012: Early ice-out => prolonged thermal stratification => severe anoxia => phosphorus release from bottom sediments => lakewide severe algae bloom in Lake Auburn & Georges Pond

The questions

- Can we enhance Maine's existing Lake Vulnerability Index, using new physicochemical **and** social science data?
- Can survey results from lake monitors and lake associations be used to enhance the Vulnerability Index through the inclusion of data on lake community stewardship capacity?
- Can survey results be used to encourage/build stewardship capacity in lake communities?

Goals & objectives

- (a) Enhance Maine's Lake Vulnerability Index to predict which lakes are more susceptible to deteriorations in water quality
- (b) Use surveys and interviews to identify factors that encourage successful collaborations among VLMP lake monitors & lake associations on lake stewardship activities
- (c) Develop a blueprint of activities - informed by our physical and social scientific findings - that can positively influence stewardship behaviors among the public

The study lakes

low ← trophic state → high

citizen involvement ↑ high ↓ low	Thompson (4400*) Emden (1568) Hopkins (442)	Long (2700) Great (8240) Messalonski (3500) North (2900)	Salmon (666)/McGrath (486) East (1823)
	Pleasant in Casco (1312) Clearwater (750) Pleasant in Caratunk (1120)	Damariscotta (4400) Mousam (900)/Square (840) Taylor (650) Meddybemps (6765)	Sabbatus (1960) Unity (2500) Webber (1200)
	Tunk (2010)	Auburn (2260)	China (3844)

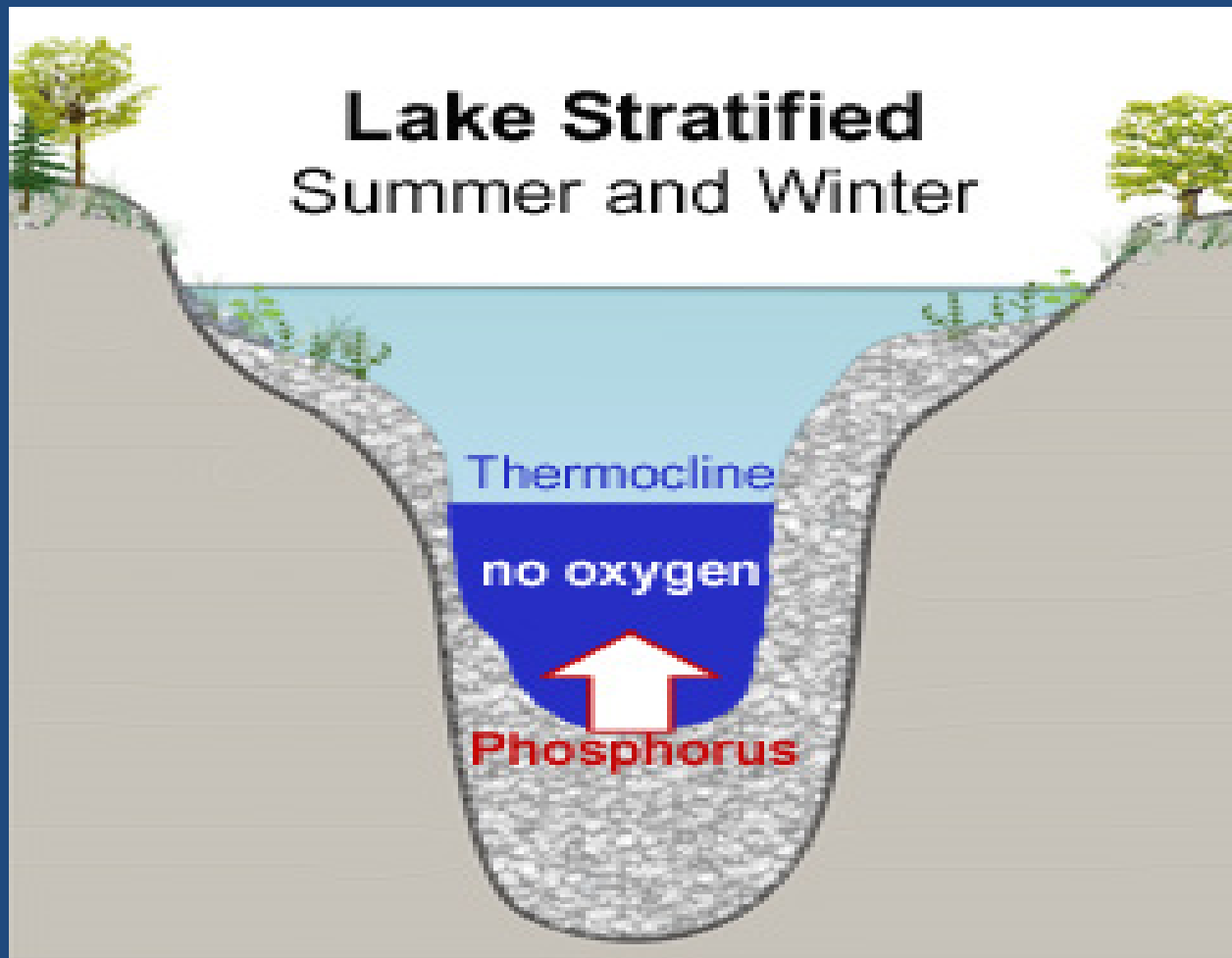
* Numbers are lake surface area in acres

Working with VLMP Certified Lake Monitors

Transparency
Dissolved Oxygen &
Temp
Water Samples
Chlorophyll a
Total Phosphorus
Anions, Cations
DOC, pH, ANC
Sediment Samples
Al, Fe, P speciation

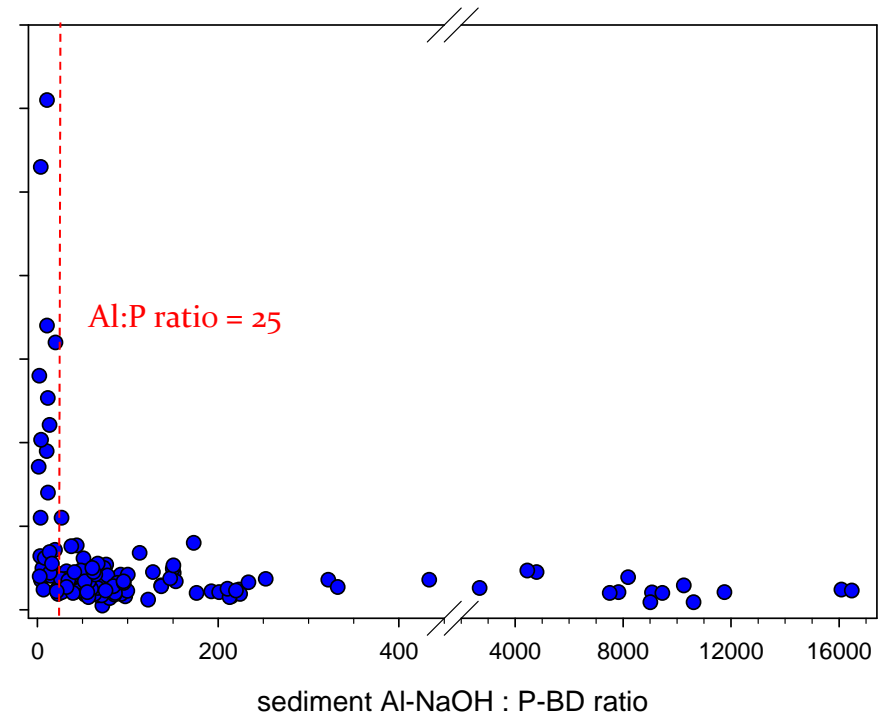
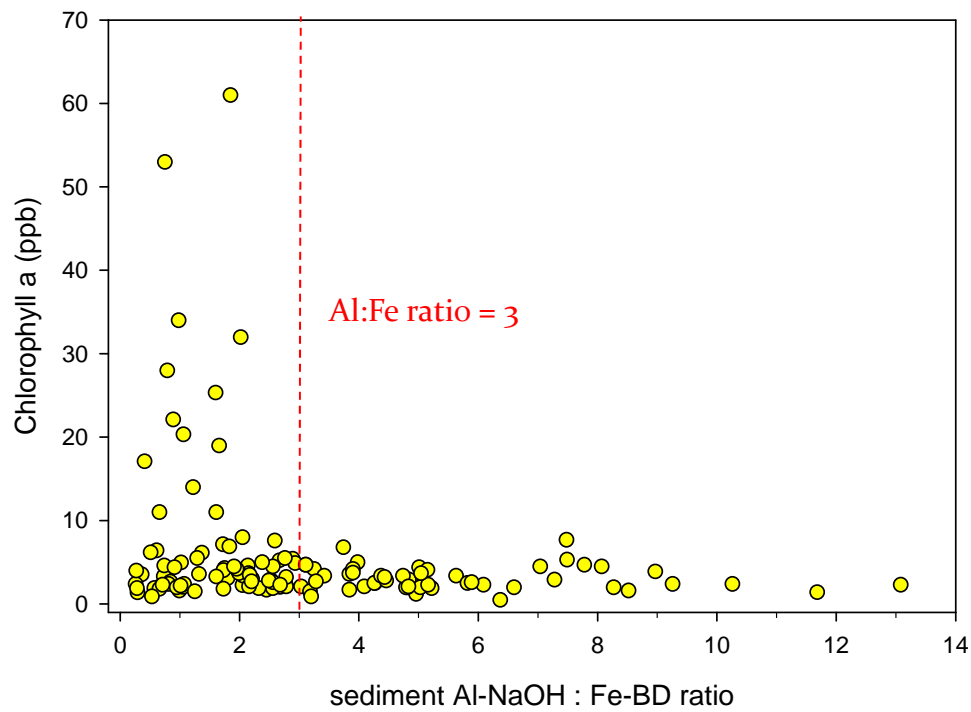


Internal Phosphorus Recycling During Anoxia

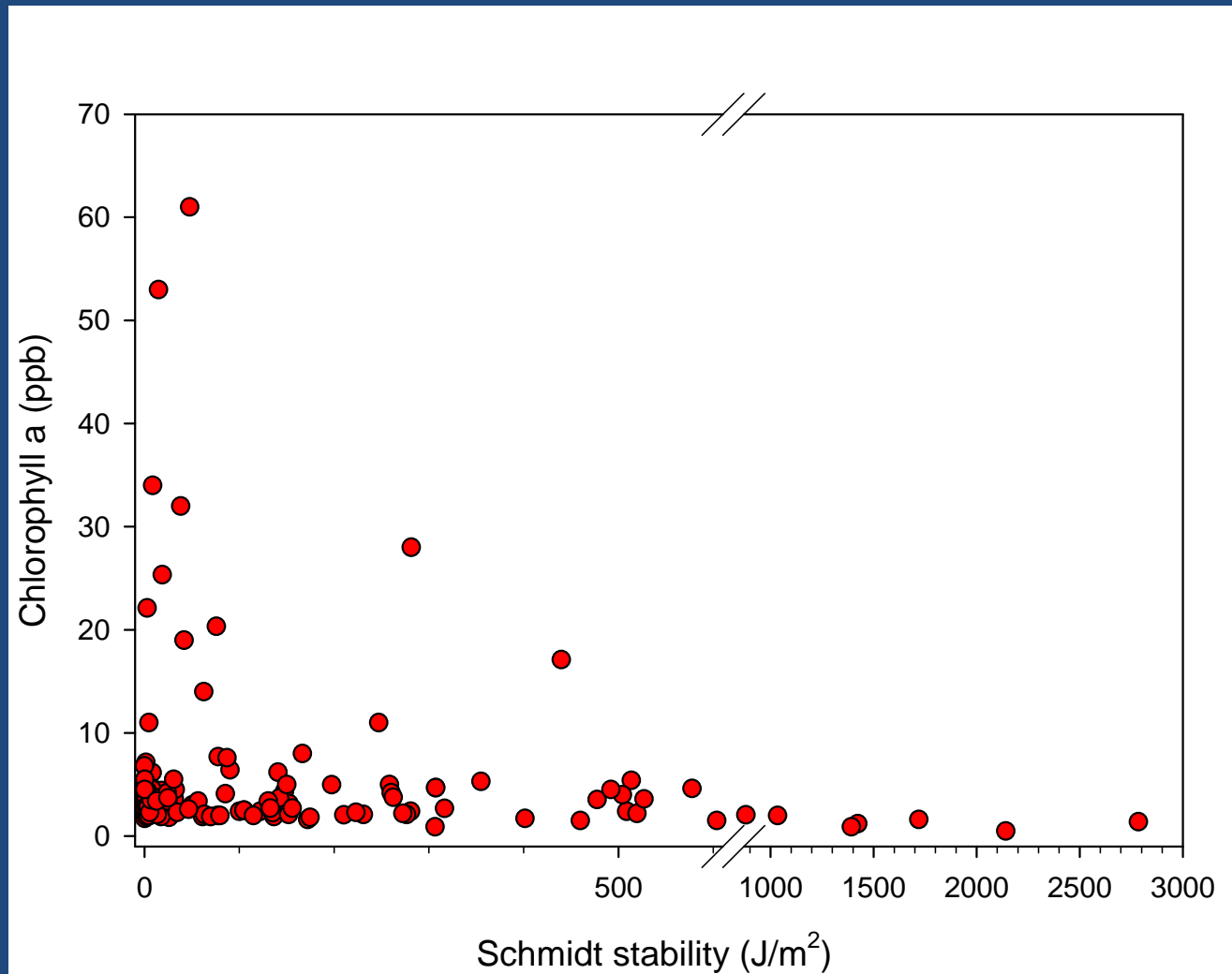




The sediment data



The physical data



The goals of surveys and focus groups

- Build a profile of citizen-stewards
- Examine what monitoring/ stewardship activities are typically conducted across lakes
- Examine factors that influence residents' involvement in lake stewardship
- Understand factors contributing to effective stewardship and active lake associations



The surveys & focus groups

- Provided to 24 lake associations in study
 - 50% of lake associations responded
 - 111 respondents
- Provided to VLMP Lake Monitors (~ 1,200)
 - 27% responded
 - 342 respondents
- Focus Groups
 - Two focus groups sessions
- Analysis
 - Qualitative content analysis
 - Descriptive analysis

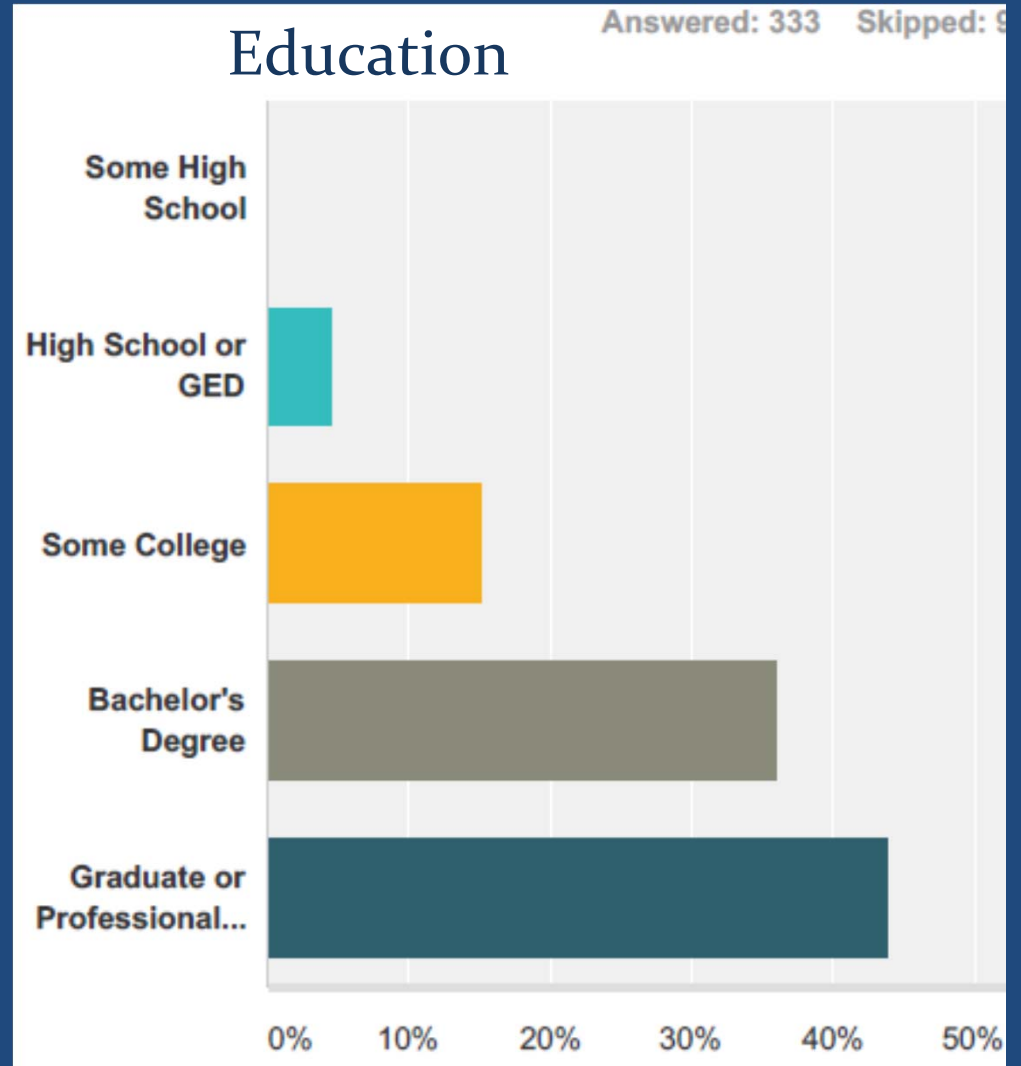
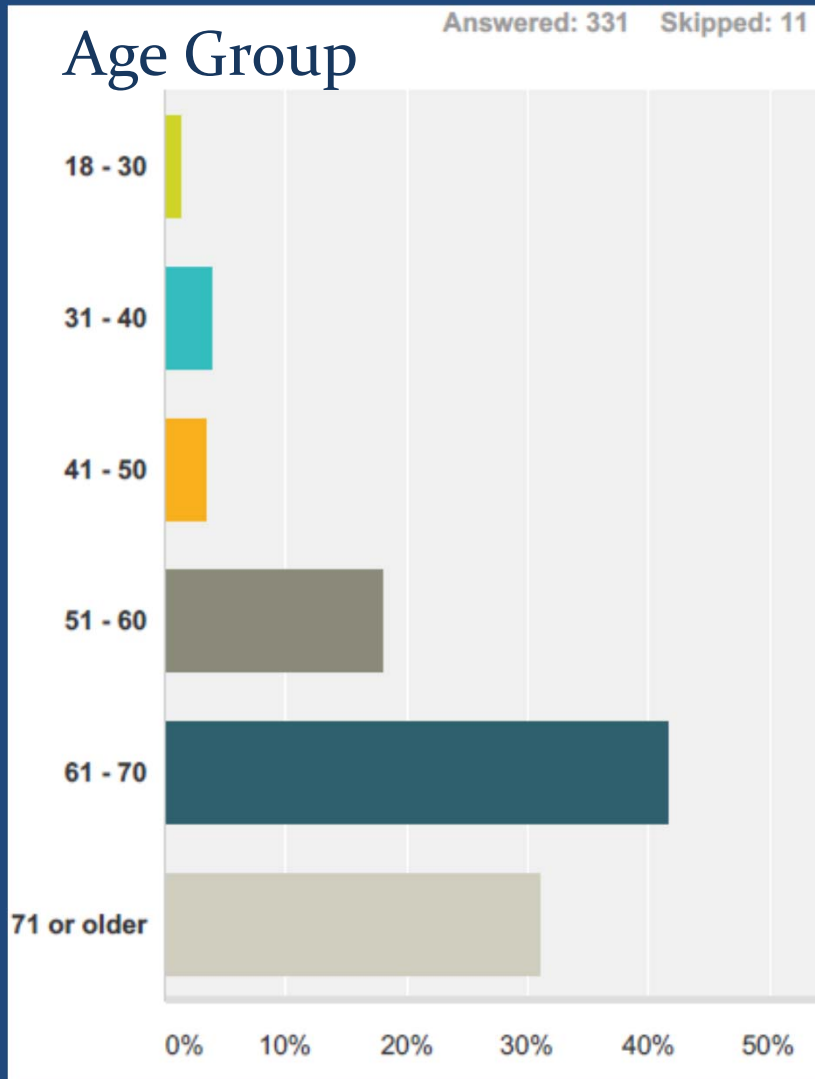


Survey Results

VLMP Lake Monitor Responses
to select questions (total 46)

Respondent profile from survey data

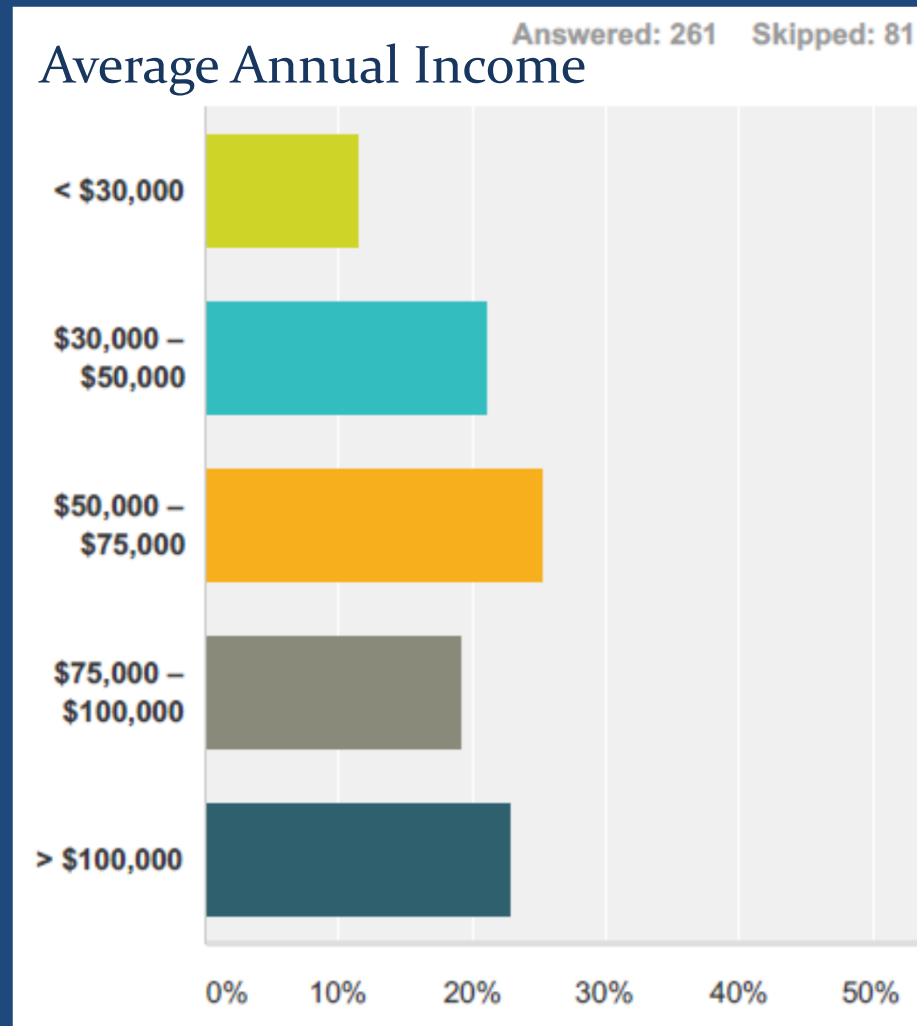
Respondents - Male: 56% - Female: 44%



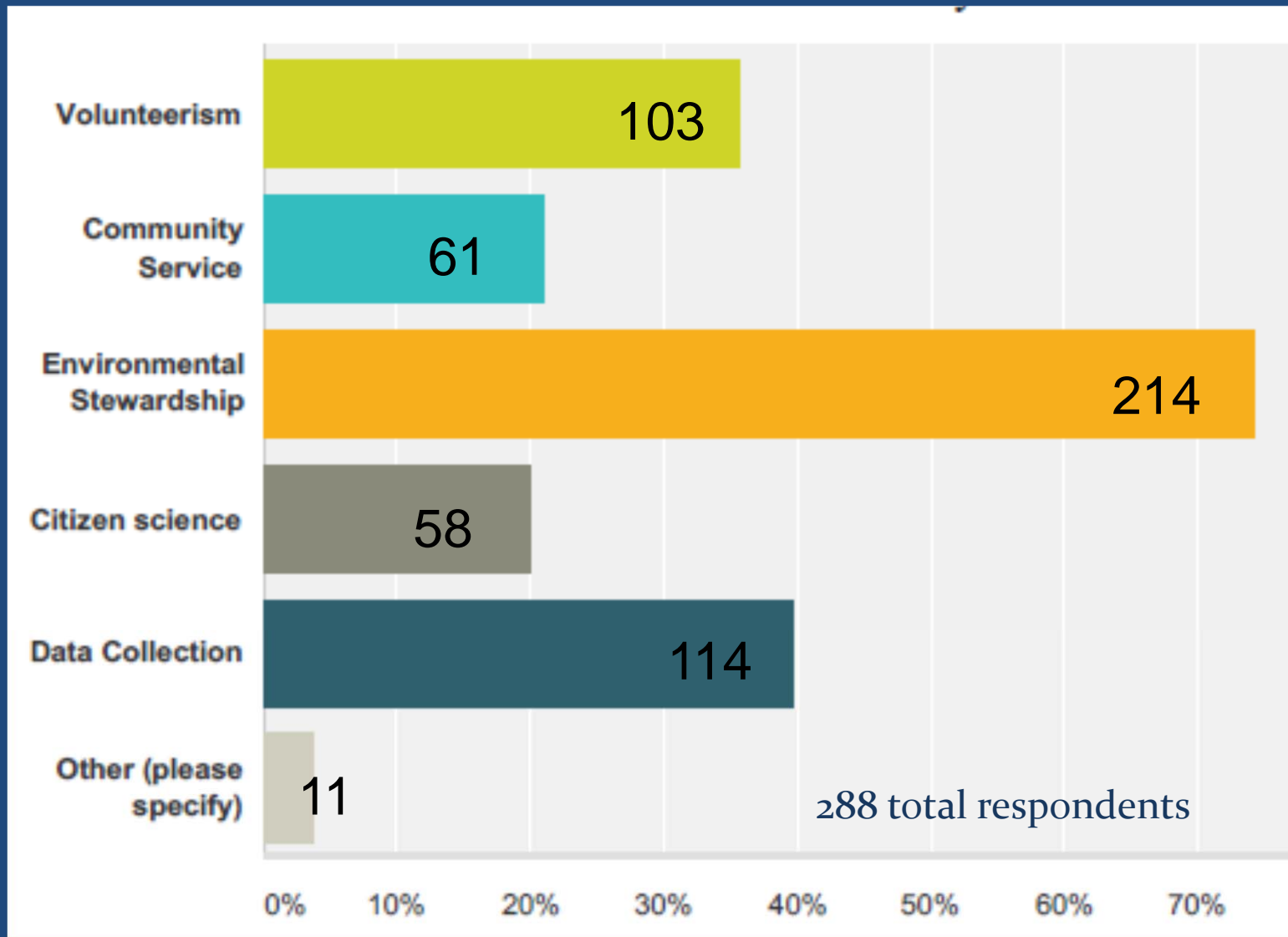
Respondent profile from survey data

Retired: 35.7% - Working: 64.3%

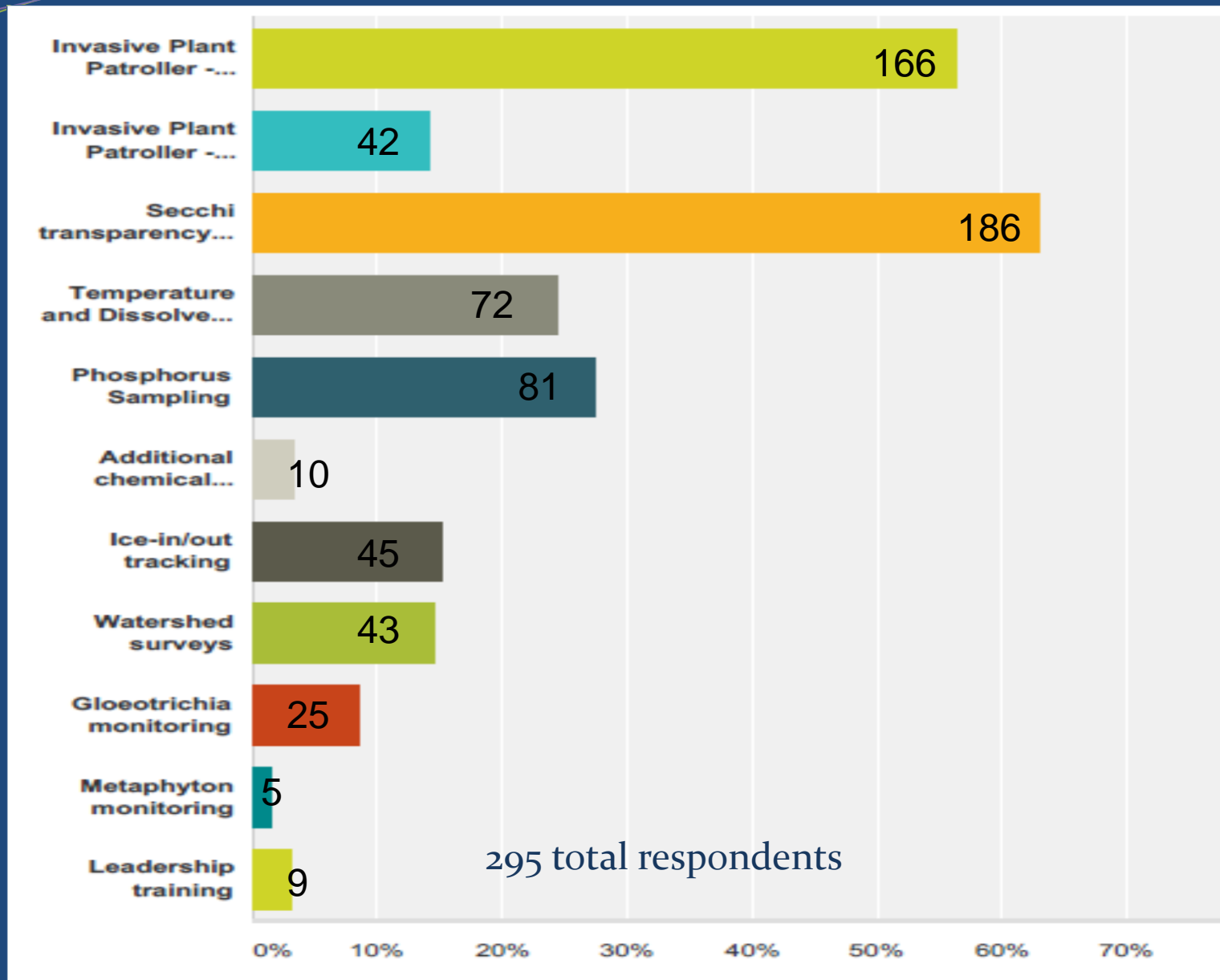
Primary residence along lake: 44.4% Yes – 55.6% No



What Two Terms Best Describe What You Do With VLMP?



VLMP Certifications received?



Please indicate what activities you engage in as a VLMP Volunteer Lake Monitor

Answered: 280 Skipped: 62

Answer Choices	Responses	
★ Collect water quality data	85.00%	238
★ Collect invasive species data	75.71%	212
★ Collect data on other watershed indicators	58.93%	165
★ Help coordinate workshops for VLMP Lake Monitors	58.93%	165
Help coordinate workshops for Lake Associations	60.36%	169
Assist DEP or VLMP staff in the collection of baseline samples from your lake	60.71%	170
Help coordinate equipment and support for VLMP Lake Monitors	60.36%	169
★ Answer data collection related questions from volunteers	62.50%	175
Help VLMP with data quality assurance support	56.79%	159
Help VLMP with ground truthing and verifying collected data, e.g., taking Secchi readings during satellite flyover days	59.29%	166
★ Help coordinate lake related events	62.86%	176
Help VLMP collate and enter data into the system	56.07%	157
Other, please specify	38.21%	107

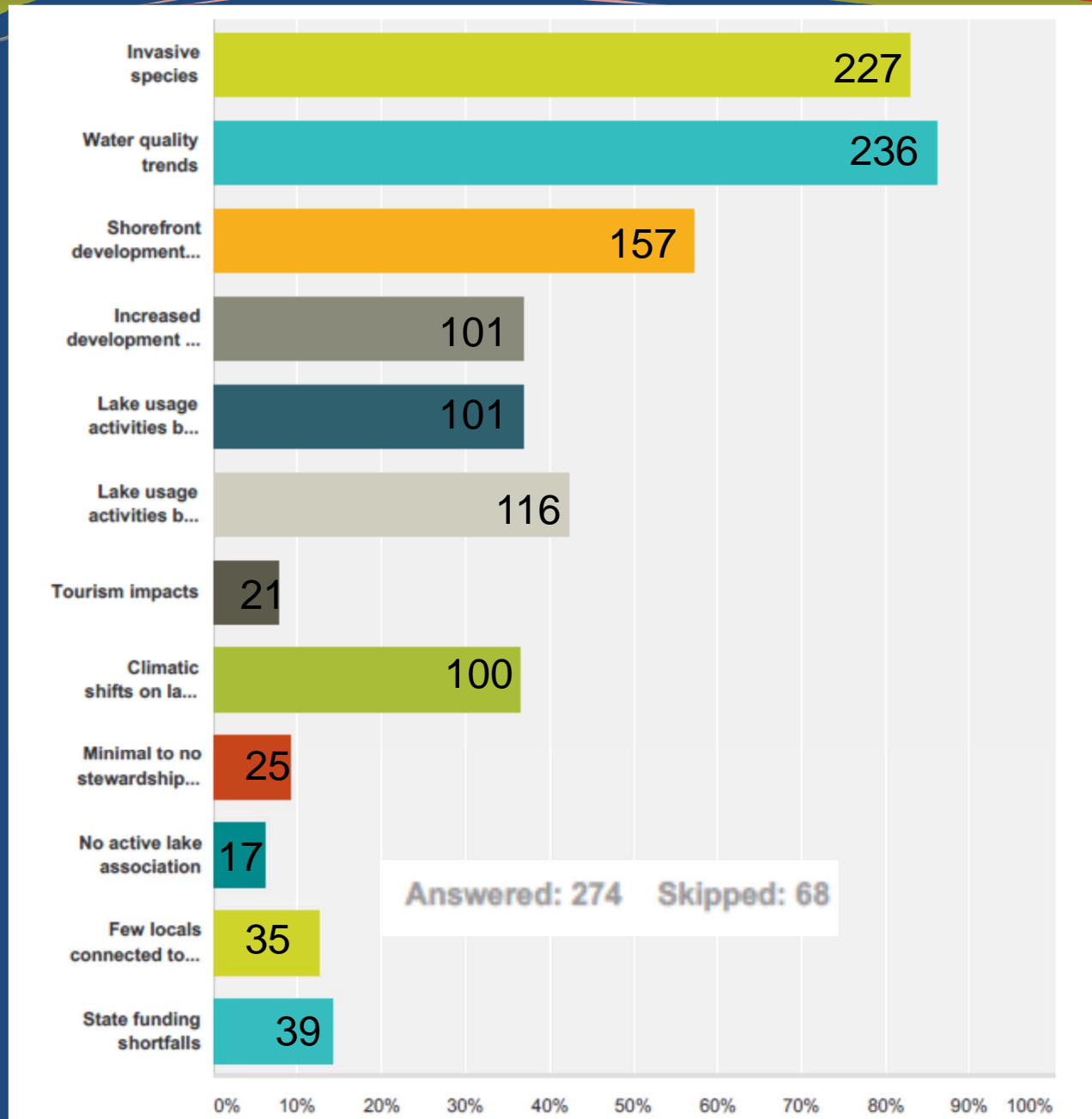
What motivates you?

	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree	No Comment	Total	Weighted Average
Gives me an outdoor activity to do during the spring/summer/fall	3.91% 11	8.54% 24	25.98% 73	34.52% 97	25.98% 73	1.07% 3	281	3.73
Keeps me busy and active	3.93% 11	10.71% 30	33.93% 95	32.86% 92	17.14% 48	1.43% 4	280	3.53
I have a deep personal attachment to the pond/lake/s I monitor	1.06% 3	0.71% 2	3.89% 11	15.55% 44	75.62% 214	3.18% 9	283	4.73
I am concerned about the health of the pond/lake that I monitor	1.05% 3	0.00% 0	1.75% 5	12.63% 36	80.35% 229	4.21% 12	285	4.84
Keeps me involved with my lake community	0.36% 1	3.57% 10	15.71% 44	38.93% 109	38.93% 109	2.50% 7	280	4.20
Helps maintain the current state of the pond/lake I monitor	1.06% 3	0.35% 1	7.80% 22	23.76% 67	63.12% 178	3.90% 11	282	4.59
I want to give back through community service	0.71% 2	2.83% 8	18.37% 52	35.34% 100	40.28% 114	2.47% 7	283	4.19
I believe in VLMP's mission	0.71% 2	0.35% 1	2.47% 7	18.73% 53	74.20% 210	3.53% 10	283	4.76
I help monitor an important resource for the state of Maine	1.07% 3	0.71% 2	4.63% 13	32.03% 90	58.72% 165	2.85% 8	281	4.55
I can learn about lake science	1.06% 3	2.82% 8	14.44% 41	39.44% 112	40.85% 116	1.41% 4	284	4.20
I can contribute to lake management decisions	2.17% 6	2.54% 7	30.07% 83	35.87% 99	26.09% 72	3.26% 9	276	3.91
I can contribute to lake science monitoring data	0.72% 2	1.08% 3	11.11% 31	41.22% 115	42.65% 119	3.23% 9	279	4.34
I meet like-minded people	1.08% 3	2.17% 6	29.24% 81	42.96% 119	22.74% 63	1.81% 5	277	3.90
It helps indirectly maintain lake front property values	2.52% 7	3.96% 11	23.02% 64	34.89% 97	32.37% 90	3.24% 9	278	4.00
It helps indirectly maintain tourism revenue	4.66% 13	7.89% 22	41.22% 115	27.24% 76	14.34% 40	4.66% 13	279	3.53
It gives me a deep sense of personal satisfaction	1.07% 3	1.79% 5	6.79% 19	37.14% 104	51.43% 144	1.79% 5	280	4.41

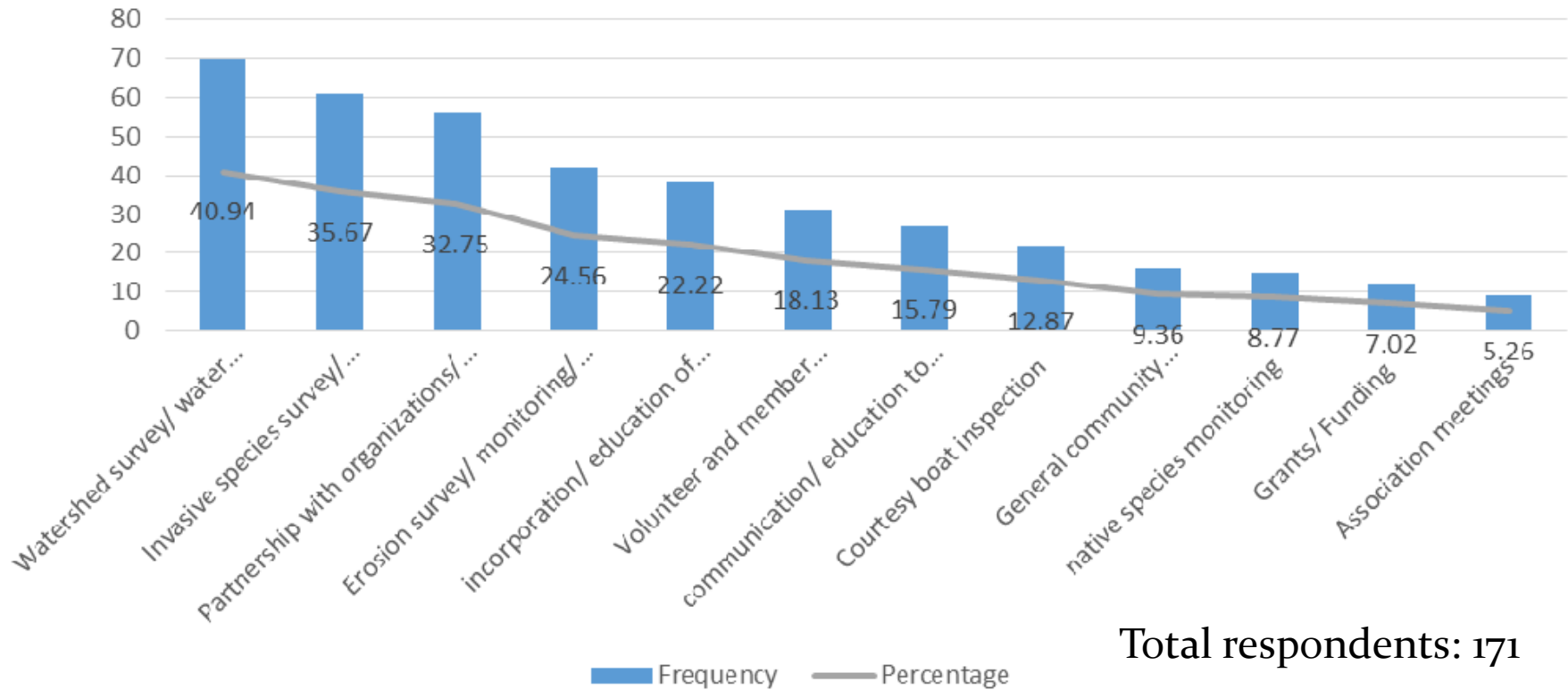
What Motivates You (5 highest)

- I am concerned about the health of the lake that I monitor (Strongly Agree (80%), or Agree (13%)
- I believe in VLMP's Mission (Strongly agree 74%; Agree 19%)
- I have a deep personal attachment to the lake that I monitor (Strongly agree 76%; Agree 16%)
- I help monitor an important resource for the State of Maine (Strongly agree 59%; Agree 32%)
- Helps maintain the current state of the lake that I monitor Strongly agree 63%; Agree 24%

Chief concerns for the lake you are familiar with and where you collect data

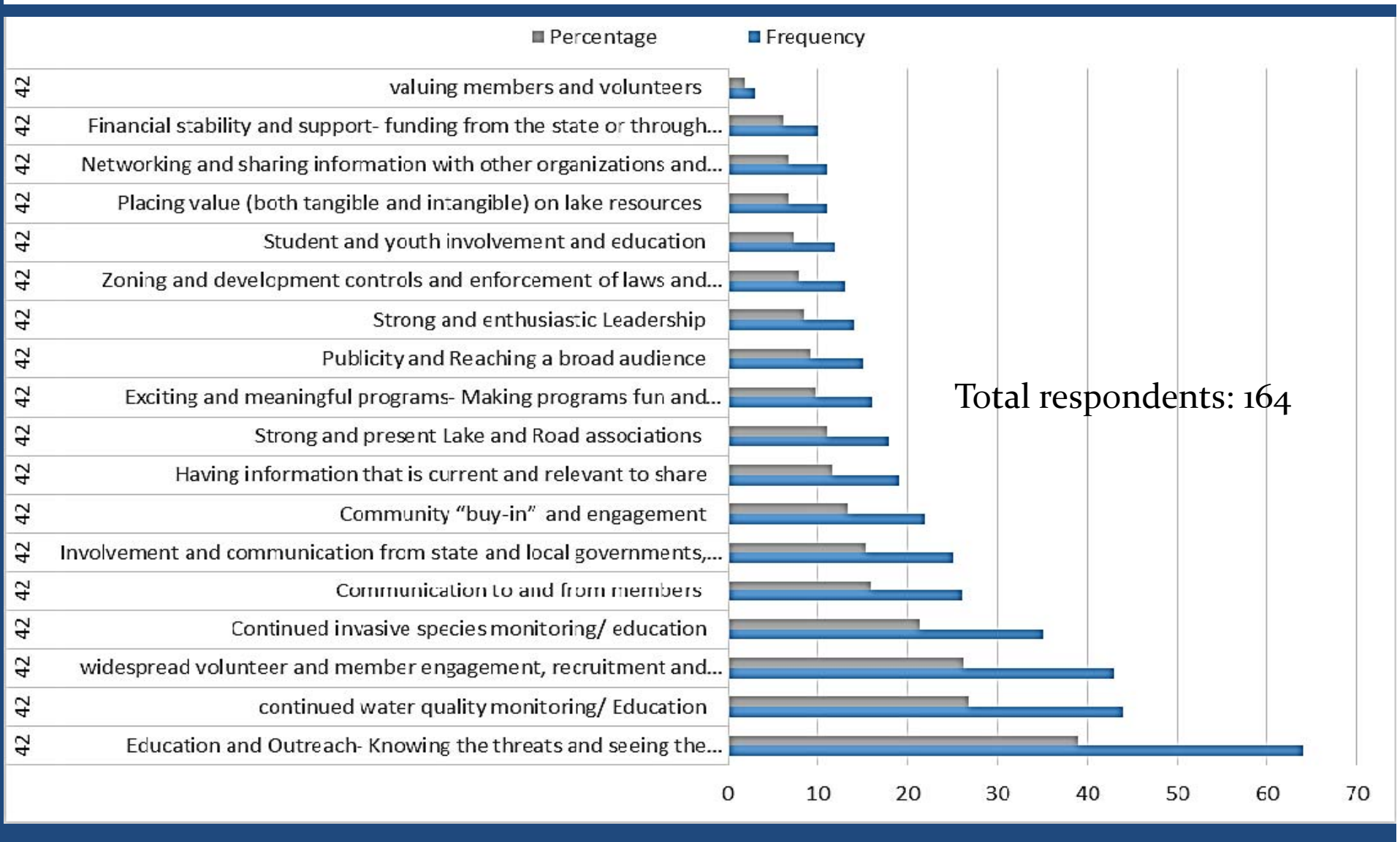


Q41 “ Please describe any lake stewardship activity that you have engaged in or observed that you believe can have very positive outcomes for lake management.”



Surveying and monitoring; Partnerships; Communication & Education

Q 42 – Please specify 2 key factors that you think are critical for effective and long-term stakeholder involvement in lake stewardship.

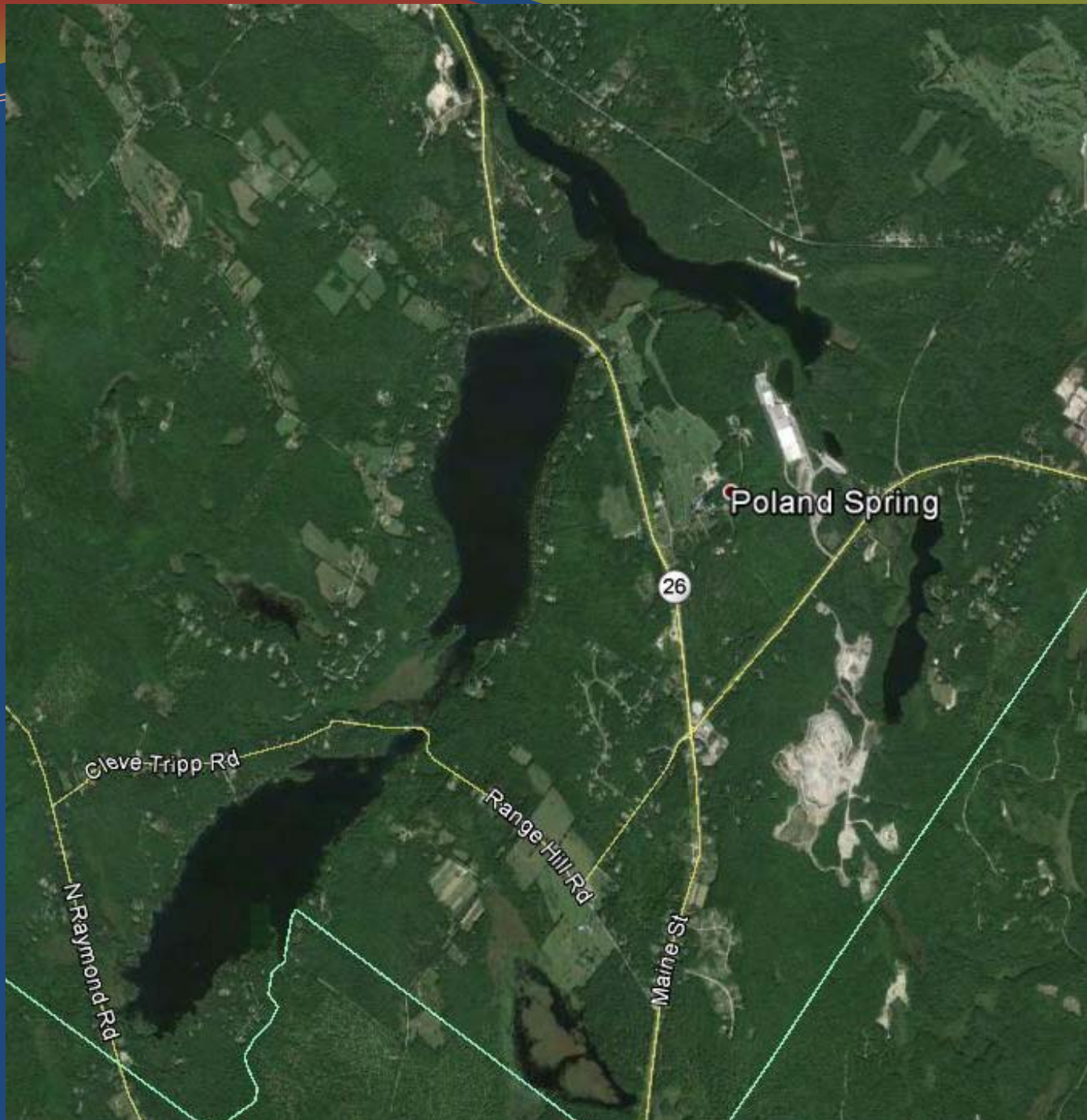


Preliminary survey analysis

- High level of commitment and purposeful stewardship
- Education, communication, and outreach
- Building social capital (self organizing; nested relationships/networks)
- Deliberative and collaborative efforts
- Involvement of younger generation
- Role of supporting institutions

The next steps...

- Reporting on the analysis of results from two surveys and focus groups
- Survey additional lakes identified for the study
- Hold information dissemination/best practices workshop with Lake Associations & VLMP lake monitors to communicate our findings





Stay Tuned!

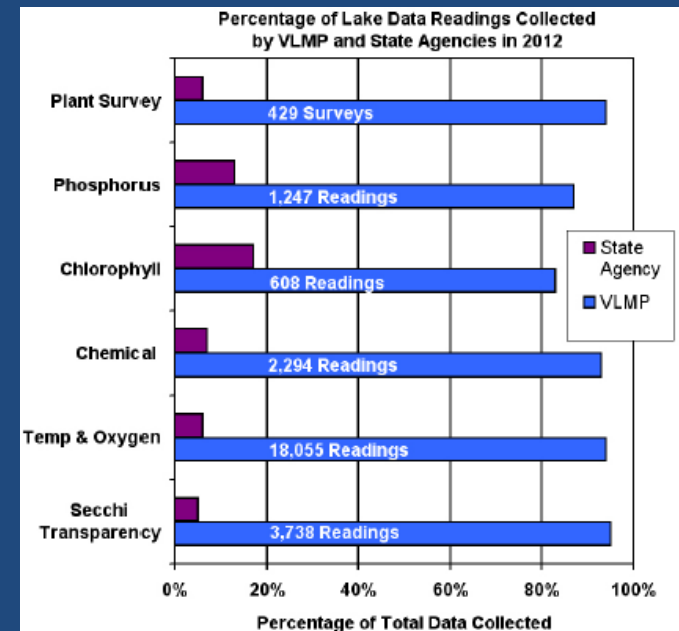
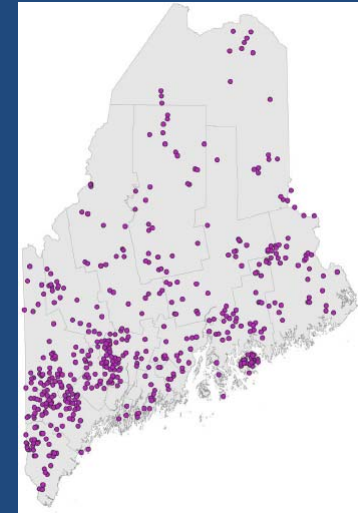
The background - *DEP*

- GPA Classification attainment status
- Status determined by trophic parameters
 - Secchi Disk Transparency
 - Chlorophyll, Phosphorus,
 - Dissolved Oxygen
- Federal Non-point Source Funds (Section 319)
- Non-attainment/Impaired lakes - Restoration
- At-risk lakes - Protection



The background - VLMP

- Founded 1971
- Oldest volunteer lake monitoring program in nation
- ~1,400 Certified Water Quality Citizen Scientists
- Monitor over 400 lake stations
- Collect 10x data as DEP
- Stewardship catalyst



The background – *Collaborative History*

- 1998 – Stakeholder DEP contacted UM geochemists
- Atypical lakes – anoxia without sediment P release
- Multiple projects revealing critical Al:Fe ratios in a small number of lakes
- Sawyer Lab (Clive Devoy) perfected Al:Fe:P sediment speciation techniques.
- 2010 – 2012 DEP collects sediments from 106 lakes
- 2015 Current project – Local stakeholder participation
 - Physicochemical data collection
 - Social surveys

The resource

- Lakes are 'gems' on Maine's landscape
- ~2,800 lakes 10 acres or greater in size
- Home to a diversity of fish and wildlife
- Perform various ecosystem services
- Activity related to Maine lakes, contributes approximately \$4 billion/year to the state economy



Q43 “Please specify 2 factors that you think are critical to keep lake associations active in their lake stewardship activities.”

