An Analysis of Rainwater from Rural Alaska Catchments: Findings and Recommendations for Healthy Utilization

Masters of Public Health Project Practicum

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Background and Significance

- World Health Organization (WHO)
  - Household water security defined as access to 13.2 $gp^{-1}d^{-1}$
- Water Security in Alaska
  - Highest in U.S. for proportion of homes without in-home piped water
    - Increased risk of diseases
      - Pneumonia, MRSA, Respiratory-tract Infections, Skin Infections, and RSV

(ADEC, 2009; Brubaker, 2011; Hennessy et al., 2008; Thomas et al., 2013; Eichelberger, 2010).

Research Question & Objectives

- Research Question
  - What is the quality of water in rainwater catchments in rural Alaska?
- Objectives:
  - Sample & analyze rainwater from across the state
  - Document methods and materials employed to collect rainwater
  - Provide homeowners with the results of the testing on their water
  - Discuss possibilities for healthy utilization of rainwater based on findings
  - Discuss utilization and development of community sourced volunteer sampling

Research Methods

- Sampling Protocol Development
- Volunteer Recruitment
- Sample Collection
- Processing Rainwater samples
  - UAA Lab
    - E. *coli*
  - Professional Lab (SGS)
    - Conductivity
    - Metals Scan
    - pH
    - TOC

Method - Volunteers

- Volunteer recruitment method based on Adventurers & Scientists for Conservation

  - Develop cadre of professionals traveling to difficult to reach places interested in health and science

Methodology

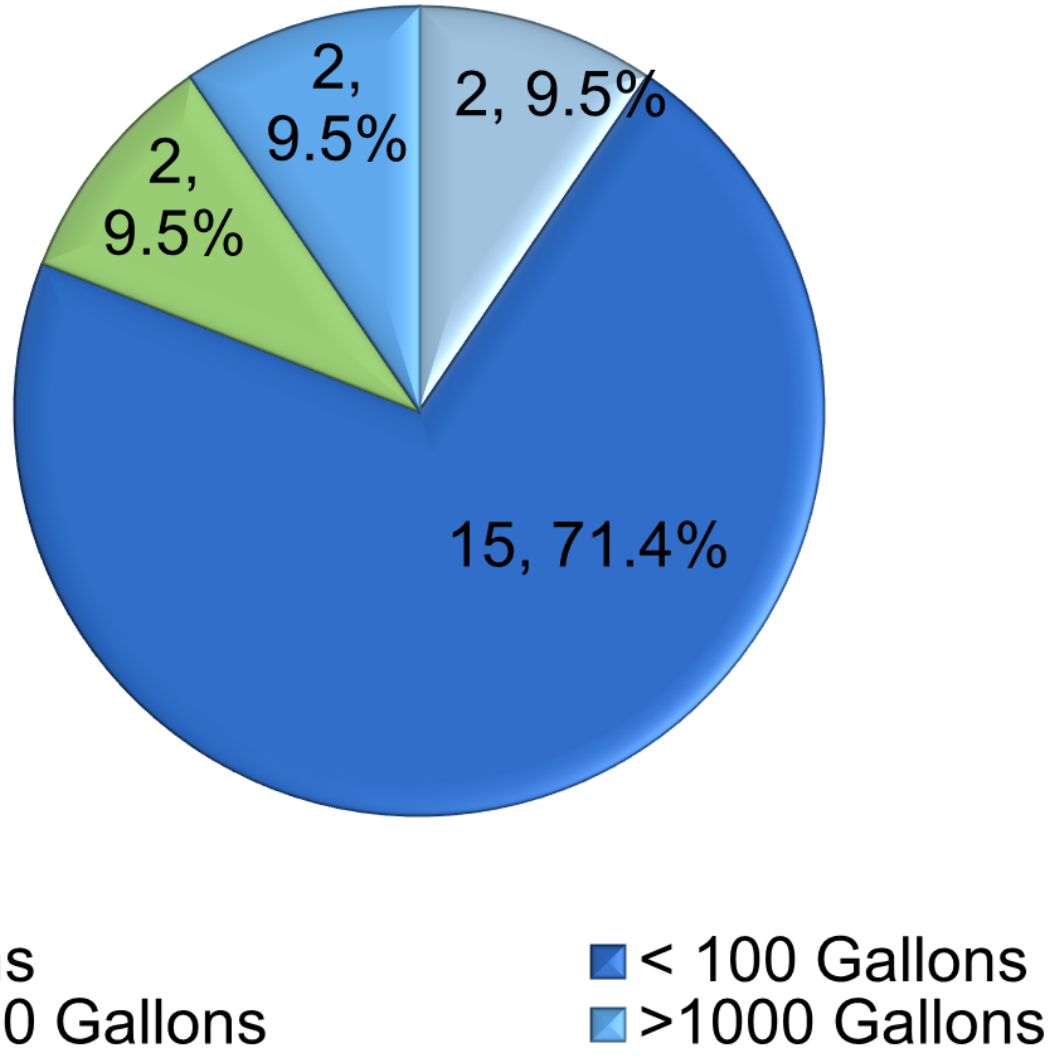
- Pilot study, convenience sample
  - Volunteers were asked to approach homes with catchments
- Sample processing Considerations
  - What was needed to ensure quality?
    - Timeline – within 3 days of Collection
    - Maintain sample temperature ($1^{0}C$ - $10^{0}C$)


Barrow
Arctic Ocean
RUSSIA
Kivalina
Kotzebue
Brevig Mission
Gambell
Nome
Fairbanks
Alakanuk
Saint Mary's
Pilot Station
Tununak
Bethel
Kipnuk
Dillingham
Anchorage
Kenai
CANADA
Bering Sea
Kodiak
Gulf of Alaska
Hoonah
Juneau
Sitka
Ketchikan
N
Legend
Sample Locations
200
Miles

Sample Locations, Samples (N), and Volunteer Group

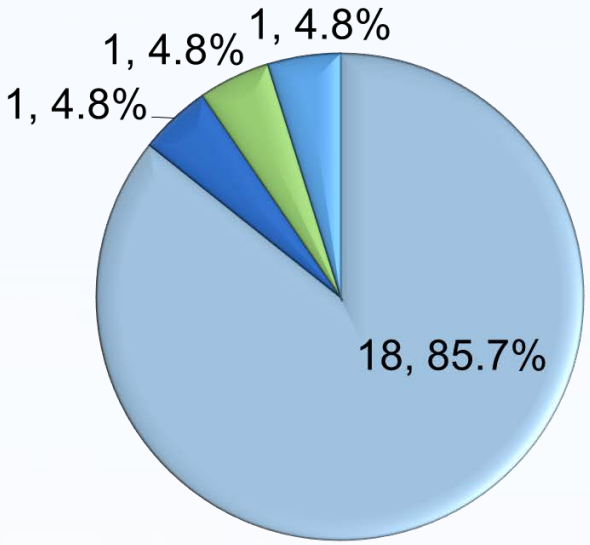
Sample Location	Samples (N)	Volunteer /Group
Alakanuk	2	Bethel Public Health Nurses
Brevig Mission	3	RurAL CAP
Gambell	1	Friend of a Friend
Hoonah	1	RurAL CAP
Ketchikan	2	Engineers
Kipnuk	7	Bethel Public Health Nurses
Kivalina	2	ANTHC
Pilot Station	1	Yukon Intertribal Watershed Council
St. Mary’s	1	Yukon Intertribal Watershed Council
Tununak	1	Friend

Size of the Catchment Vessel (N=21)

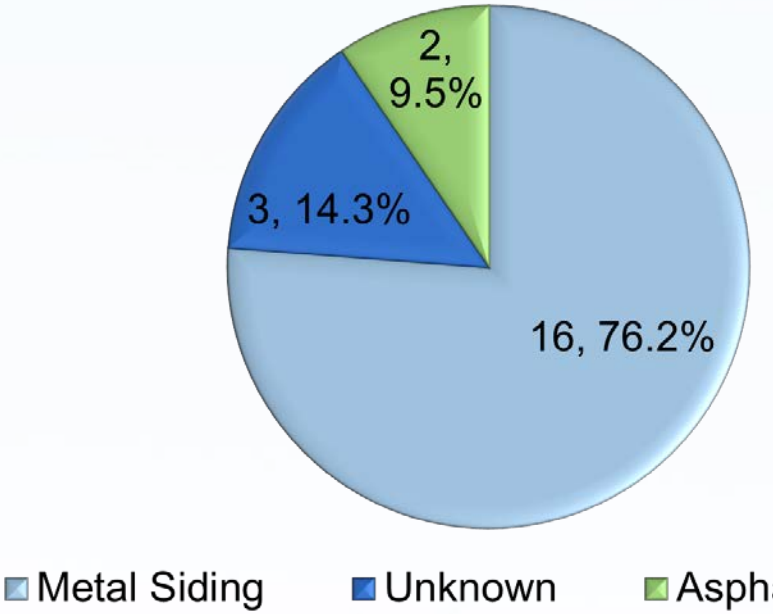


Rainwater Catchment Pictures

Material of the Rainwater Catchment Vessel (N=21)

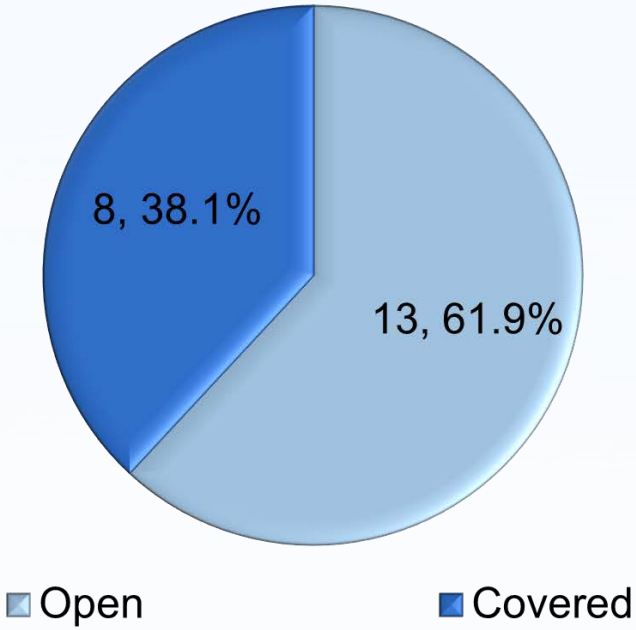


Material of the Roof Above Rainwater Catchment (N=21)

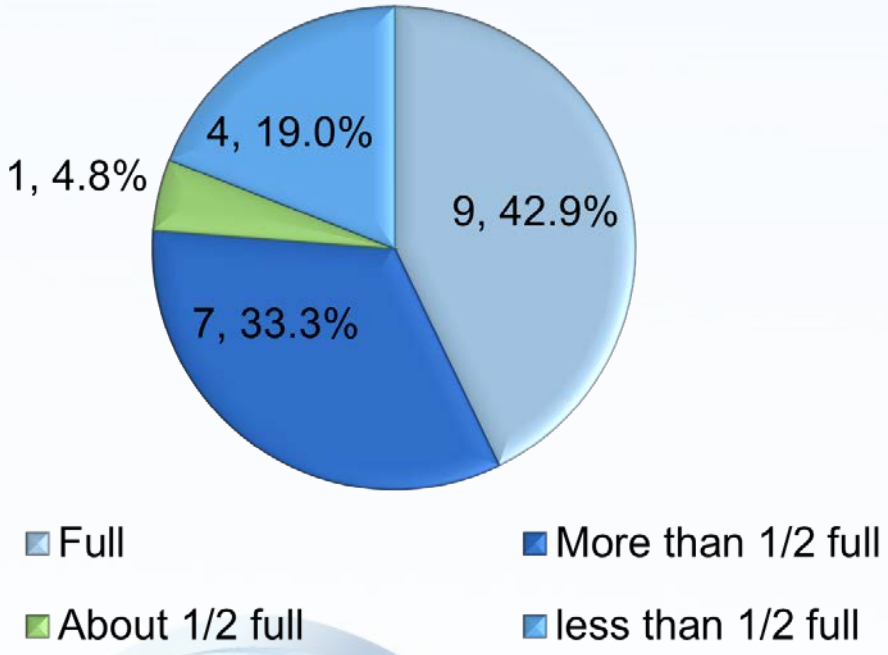


Rainwater Catchment Pictures

Was the Catchment Vessel Open or Covered? (N=21)

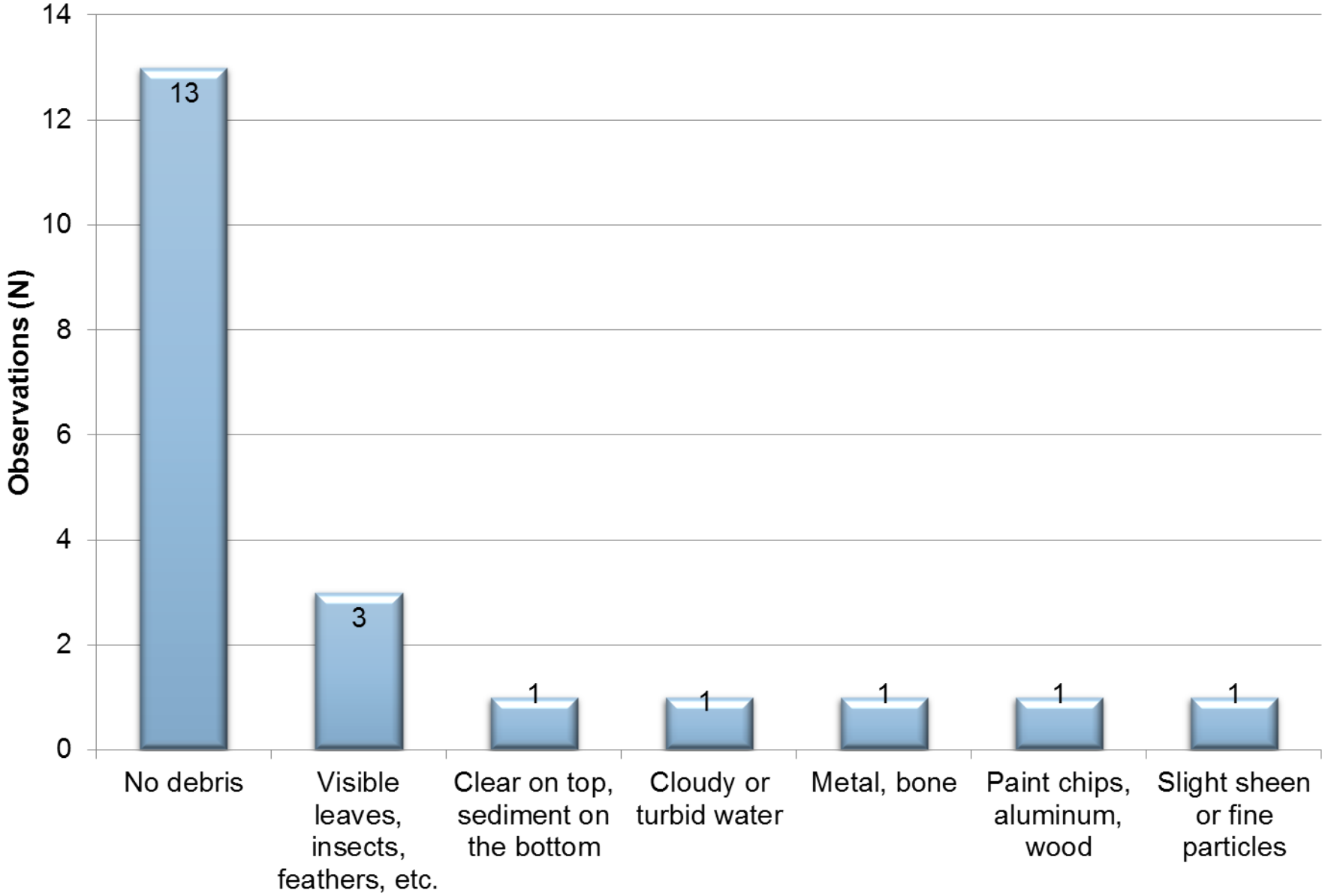


How Full was the Catchment Vessel? (N=21)



Rainwater Catchment Pictures

How Clean Did the Rainwater Look? (N=21)



Samples were tested for:

- Total Organic Carbon
- pH
- Conductivity
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc
- E-Coli

E-*coli*

- All of the 21 samples collected indicated the most probable number (MPN) for E-*coli* was 0. (6 of the 21 samples were within the time and temperature windows)
- Testing was conducted to ensure the result was accurate.

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Metal Results µg L^{-1}

Sample #	Barium	Cadmium	Calcium	Copper	Lead	Magnesium	Manganese	Nickel	Potassium	Sodium	Zinc
MCL	*2000*	*5*	*No Limit*	*secondary 1,000*	*15*	*100,000*	*secondary 50*	*100*	*10,000*	*250,000**	*secondary 5,000*
1001			2,780			1,020	5.43			5,880	179
1002			1,650				3.45			1,630	276
1003			580		4.68					1,110	2,460
1007								3.40			
1008				15.50							621
1010				10.50	1.27		27.60			3,440	3,720
1018					5.09		13.40	2.73		1,540	3,270
1019			2,150				15.30	2.55		1,820	5,140
1020					3.76		10.80	2.68		2,960	5,910
1021								2.34		2,840	445
1022	41.80	**50.30**						2.18		1,680	54
1023										3,490	47
1025	10.70		531		1.25	1,600	5.82			12,900	3,200
1026	6.02		555			1,490	3.64			11,800	83
1027	11.20		776				24.40			4,340	6,920
1028							5.73			1,840	
1029	22.60						13.70			1,760	347
1031			1,710	15.60		4,690	5.24			37,200	48
1032				297.00	11.20						
1033	4.70		3,280	605.00		3,440	17.40		2,040	28,300	43
1038							2.33				224

Limitations

- Small sample size (N=21)
- One point in time sampling
- Potential seasonal variation
- Utilization patterns of collected rainwater

Recommendations

- Additional biological testing of rainwater catchments
- Develop a set of quality standards & recommended uses for non-potable water
- How does rainwater quality compare with other non-treated sources?
- Provide health-related education for rainwater utilization
- Proper storage and containment are key to maintaining high quality water

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Questions?

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