

# Pebble Project Iliamna Lake Study



# Introduction

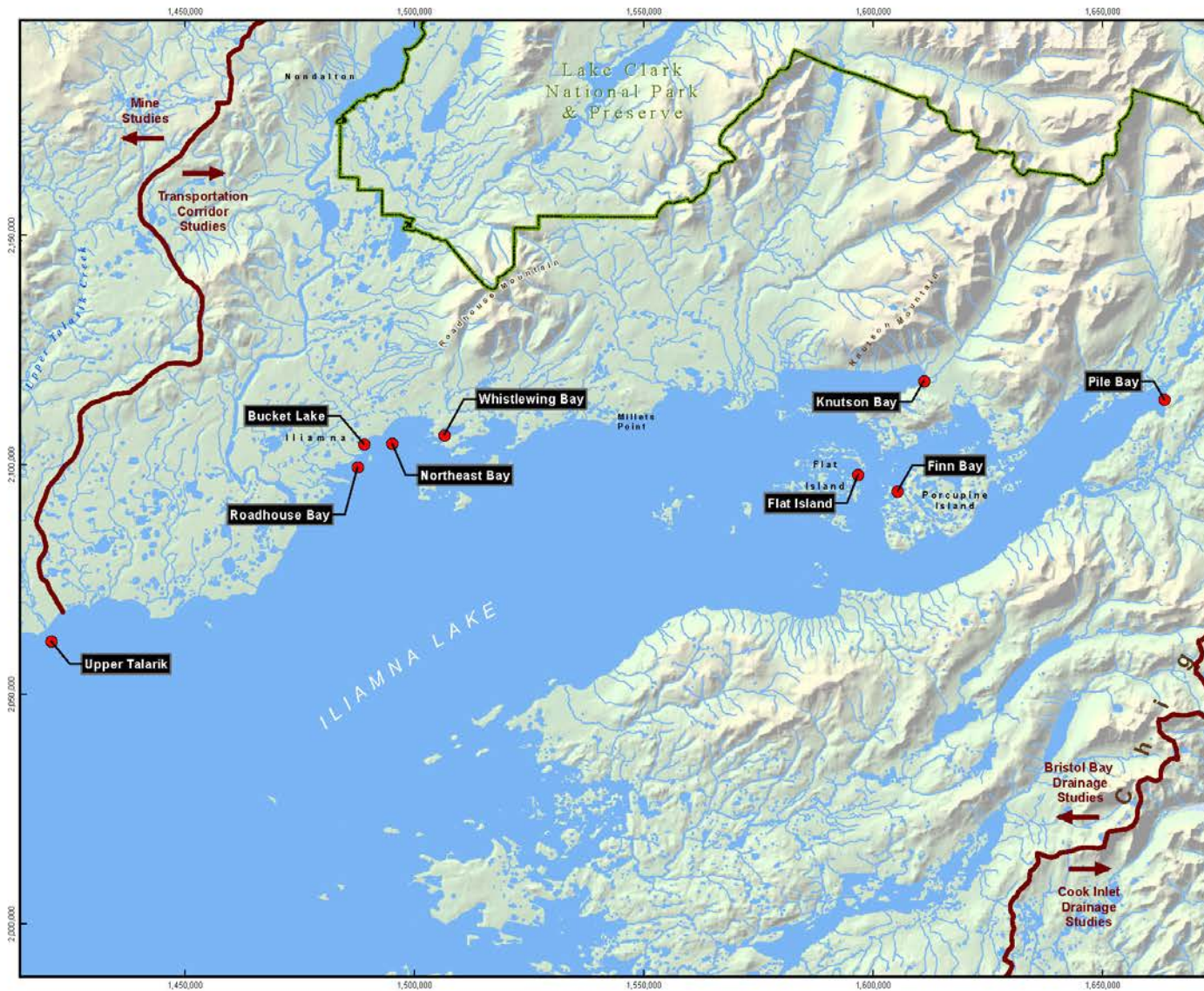
- Study Objectives
- Methodology and QA/QC
- EBD Results and Discussion
  - Surface Water Quality
  - Sediments
  - Freshwater Mussels
  - Zooplankton
- Study Team

# Objectives

- Characterize baseline conditions at select sites in the northeast end of Iliamna Lake for water quality, zooplankton, mussel tissue and sediments

# Study Area

Site Name	Samples Collected during Each Sampling Event														
	Field Parameters			Zooplankton			Surface Water			Sediments			Mussels		
	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007
Bucket Lake	x	x	x					x	x	x	x		x	x	
Finn Bay	x	x						x		x	x		x	x	
Flat Island	x	x						x		x	x		x	x	
Knutson Bay	x		x	x		x	x		x	x					
Northeast Bay	x		x	x		x	x		x	x					
Pile Bay	x		x	x		x	x		x	x					
Roadhouse Bay	x		x	x		x	x		x	x					
Upper Talarik Creek	x		x	x		x	x		x						
Whistlewing Bay		x						x			x		x	x	



**Figure B-1**  
Iliamna Lake Study Area  
and Sampling Sites,  
2005-2007

**Legend**

- Sampling Site



0 2.5 5 Miles

0 2.5 5 Kilometers

Scale 1:250,000

Alaska State Plane Zone 5 (units feet)  
1983 North American Datum

File: HDR\_Lake\_EBDFigB-1\_v01

Date: December 21, 2010

Version: 1

Author: HDR - MC

# Surface Water Field Methodology

- Field Parameter Measurements
  - YSI 556 combination meter – Temp., DO, pH, Cond., ORP
  - Hach 2100P Turbidimeter
  - Secchi Disk – water transparency measurement
- Surface-Water Samples
  - 8-L Niskin sampler
  - 3 depths
  - Dissolved Metals filtered by field team with 0.45 micron filter
  - Samples transferred to Shaw Alaska for shipping to laboratories



# Water Quality Analytes

- Laboratory parameters
  - 23 total and dissolved trace metals
  - 9 major cations and anions
  - pH, TDS, TSS, alkalinity, hardness
  - Cyanides (total, weak acid dissociable (WAD), thiocyanate)
  - Organics (one event per year)
    - Semi-volatile Organic Compounds (SVOC)
    - VOC
    - Pesticides
    - GRO, DRO, RRO

# Sediment Collection Methodology

- Sediment Samples
  - Ekman dredge
  - Samples shipped to laboratories
    - Polynuclear aromatic hydrocarbons (PAHs)
    - Total Metals
    - Mercury
    - Cyanide
    - Chloride
    - Fluoride
    - Sulfate
    - Ammonia as N

# Mussel Tissue Collection Methodology

- Mussels are as sensitive to metals as zooplankton and can be more sensitive than fish and aquatic insects (Keller and Zam, 1991)
  - Cd>Cu>Hg>Ni>Cr>Zn
- Freshwater Mussel Tissue Sampling
  - *Anodonta beringiana*
  - Mussels collected using clam basket
  - Samples shipped to laboratory
    - Polynuclear aromatic hydrocarbons (PAHs)
    - Total Metals



# Zooplankton Collection Methodology

- Zooplankton Samples
  - Plankton tow net (80 micrometer)
  - Vertical tows collected at each site (substrate to surface or 20 meters depth)
  - Samples brought to Anchorage, processed by HDR scientists
    - Specimens identified to Class (Order when possible)



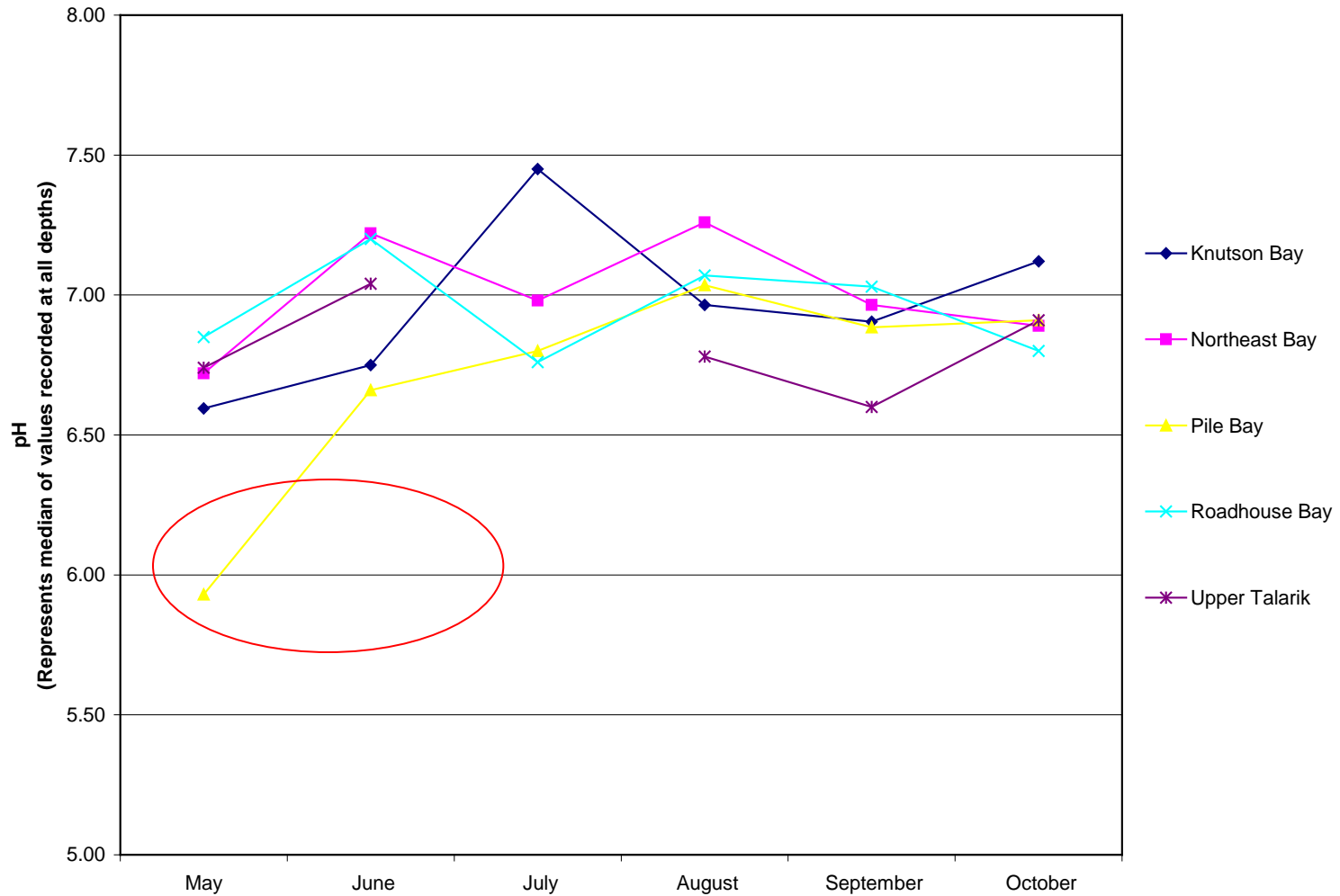
# Quality Assurance and Control

- Pebble Project QAPP
- Field Sampling Plan
  - Clean Hands/Dirty Hands; other clean procedures
  - Sampling equipment cleaned with Alconox and DI water between sites
  - 10% duplicate and triplicate frequency
  - 5% equipment rinse blanks
  - One DI blank per trip
  - One Hg trip blanks per event
- Field Audits (one per year conducted by Shaw Alaska)

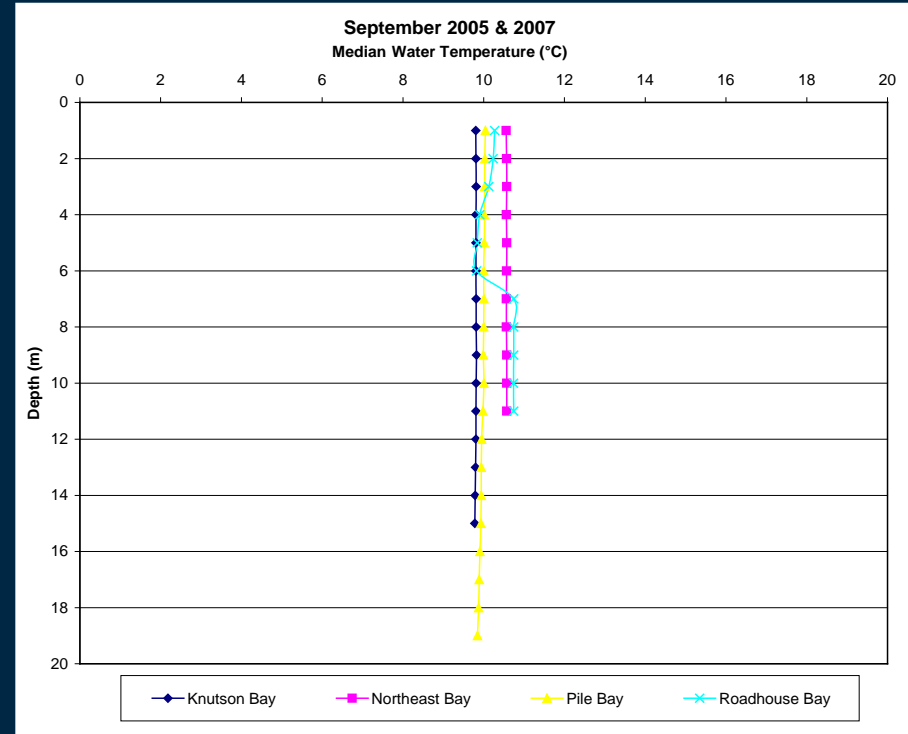
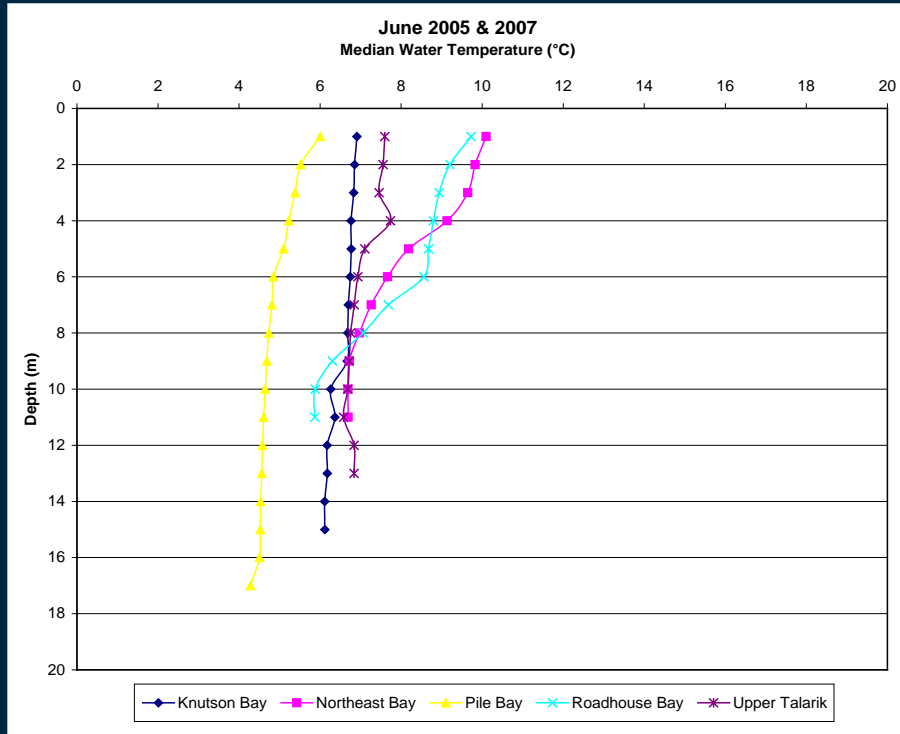
# Water Quality Results

- 176 water quality samples
- Most samples homogenous at depth (except pH, temp)
- Oligotrophic, dimictic lake
- WQ parameters similar to other regional lakes, except:
  - pH, alkalinity, copper, lead, aluminum, iron, manganese
- Pile Bay ~ higher concentrations of analytes
- Bucket Lake ~ higher concentrations of analytes
- Alkalinity is generally low
- Bioaccumulative Se and Hg undetected or relatively low concentration

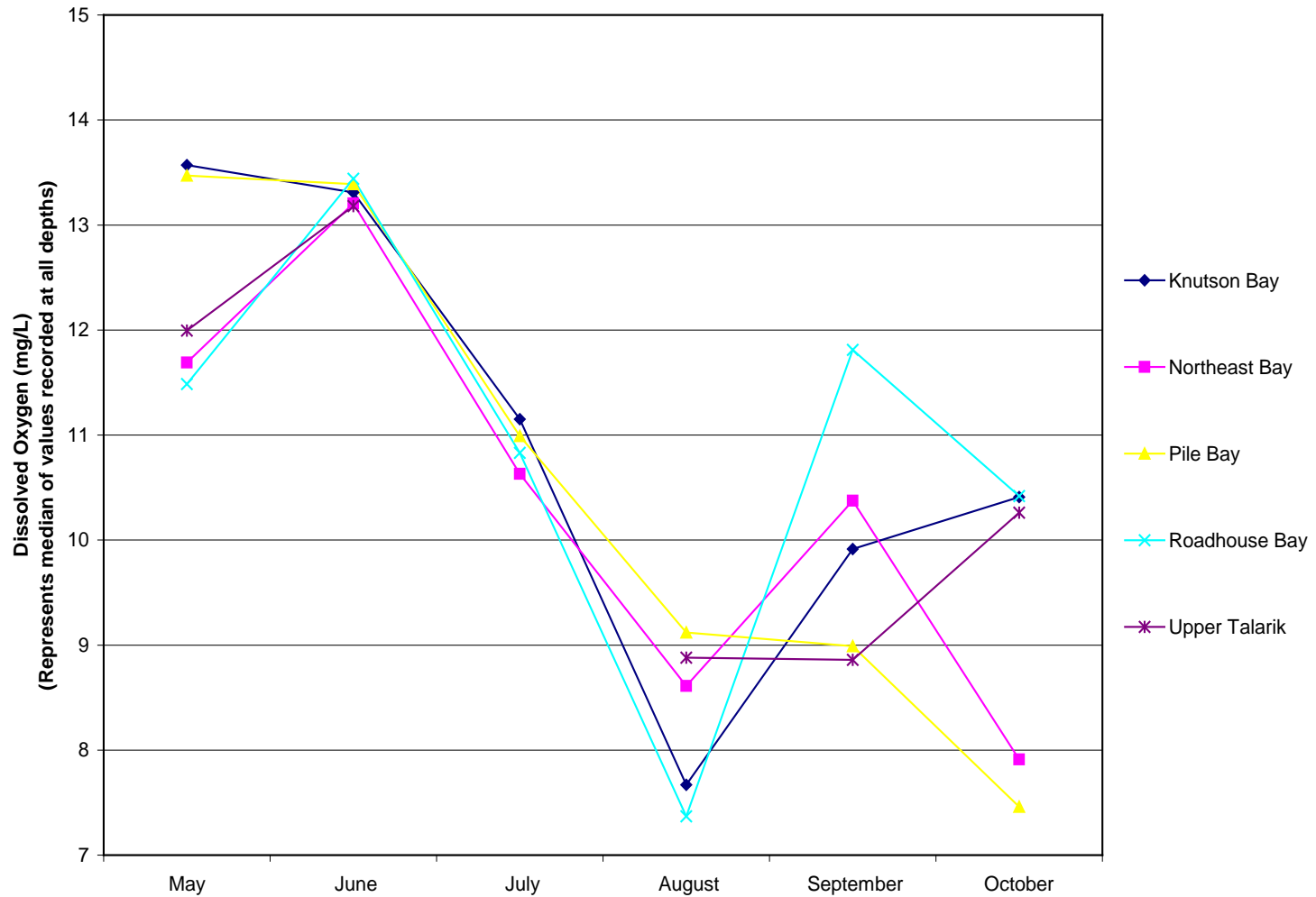
# Median pH 2005 and 2007



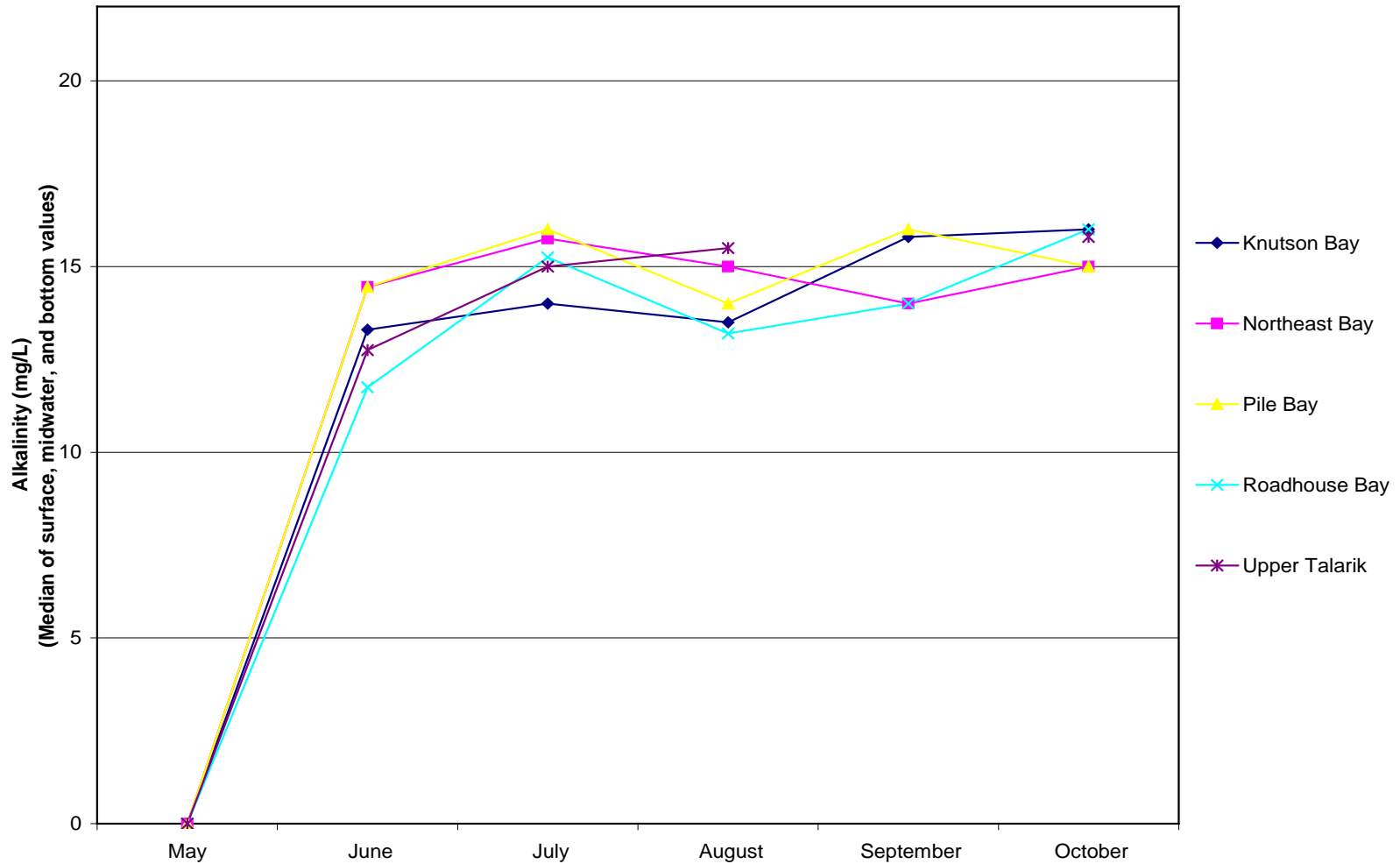
# Median Temp 2005 and 2007



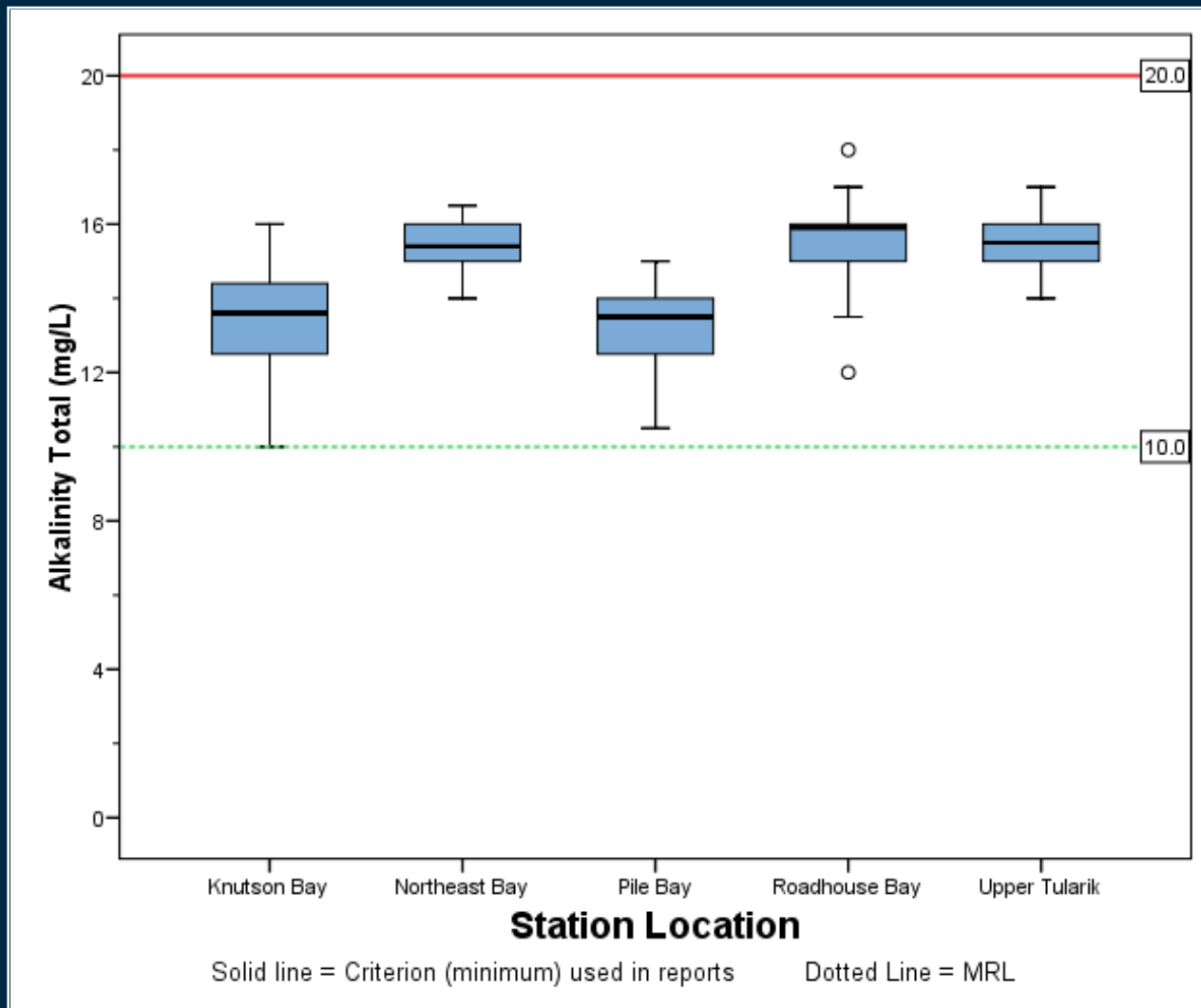
# Median DO 2005 and 2007



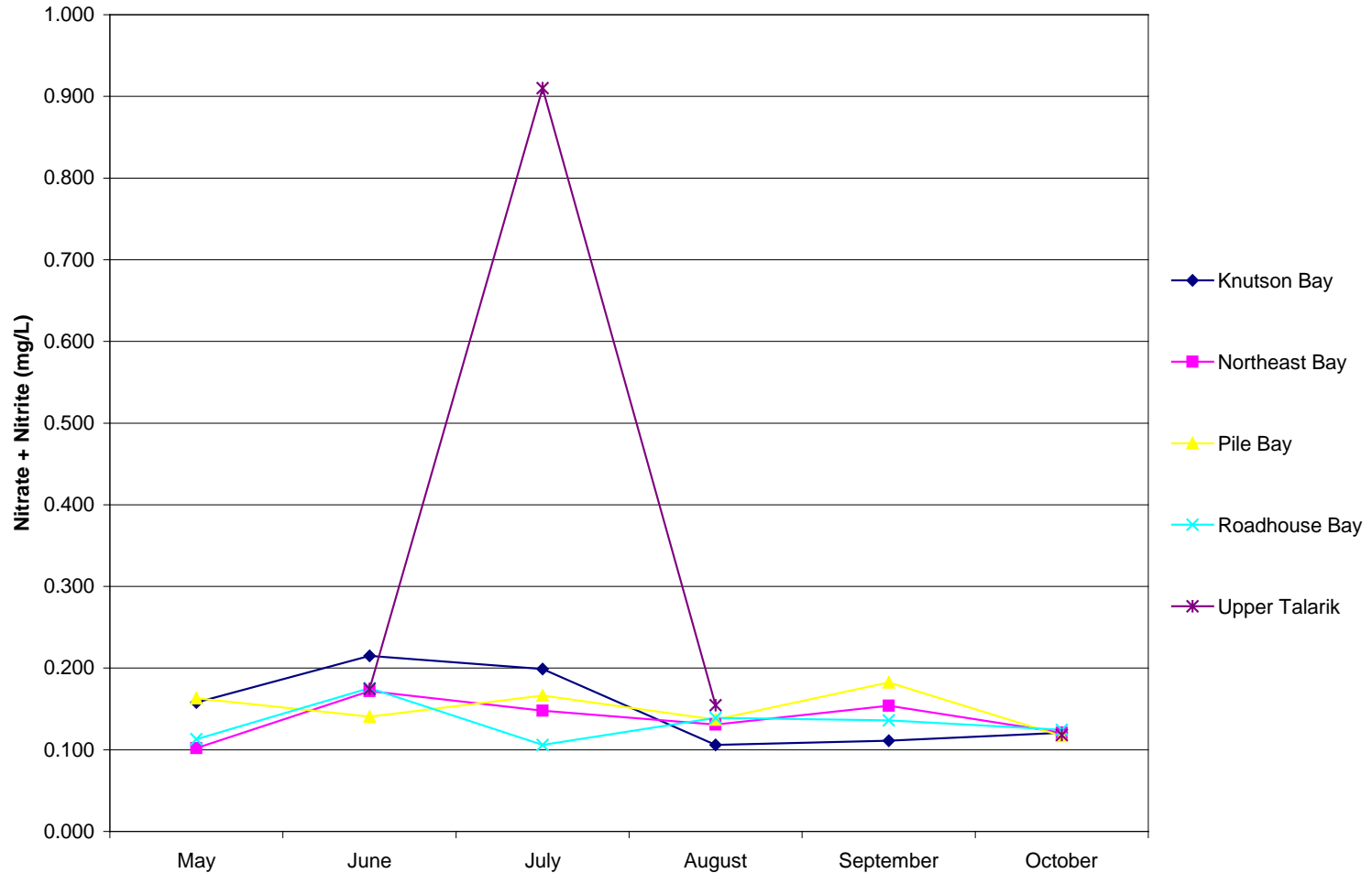
# Median Alkalinity 2005 and 2007



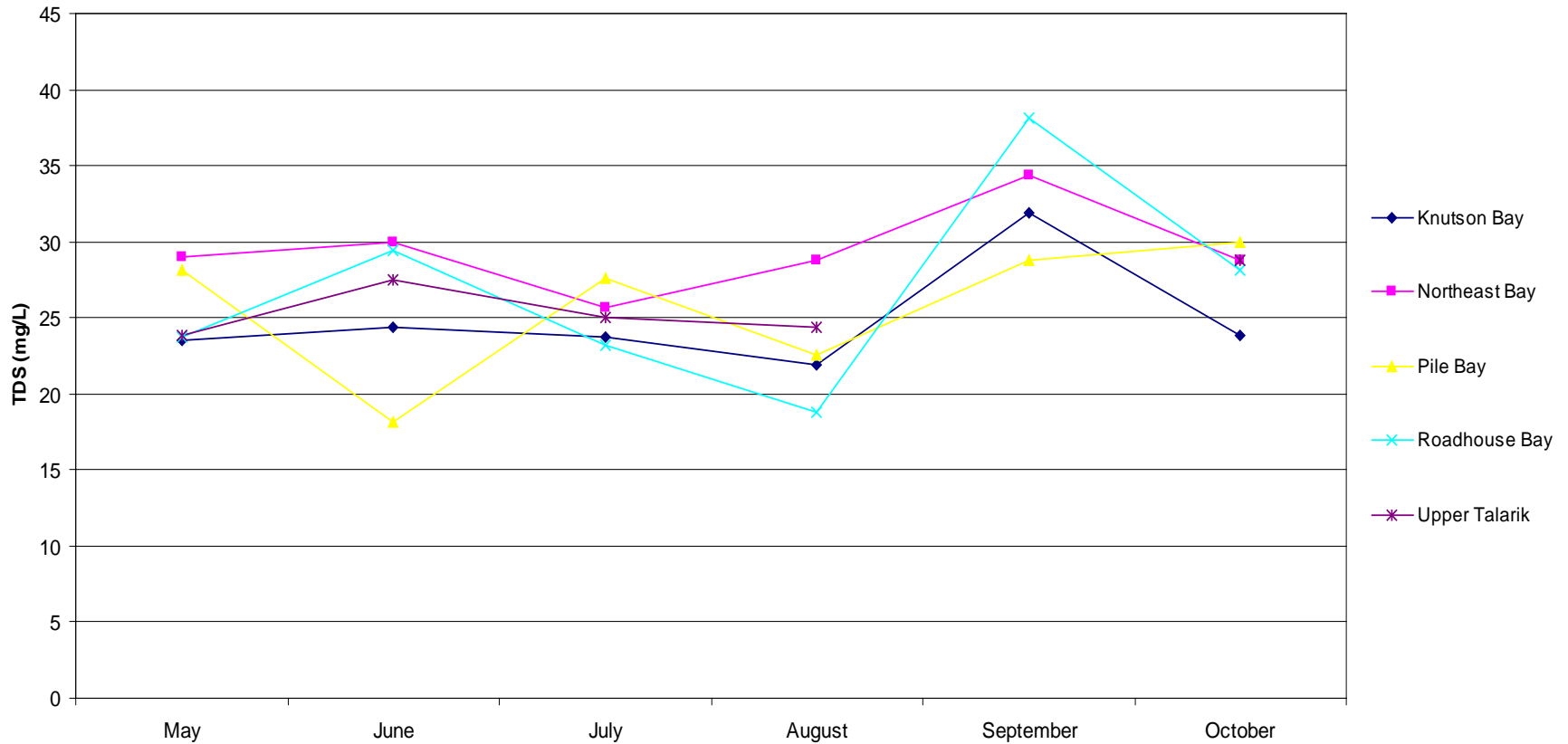
# Alkalinity Box Plot



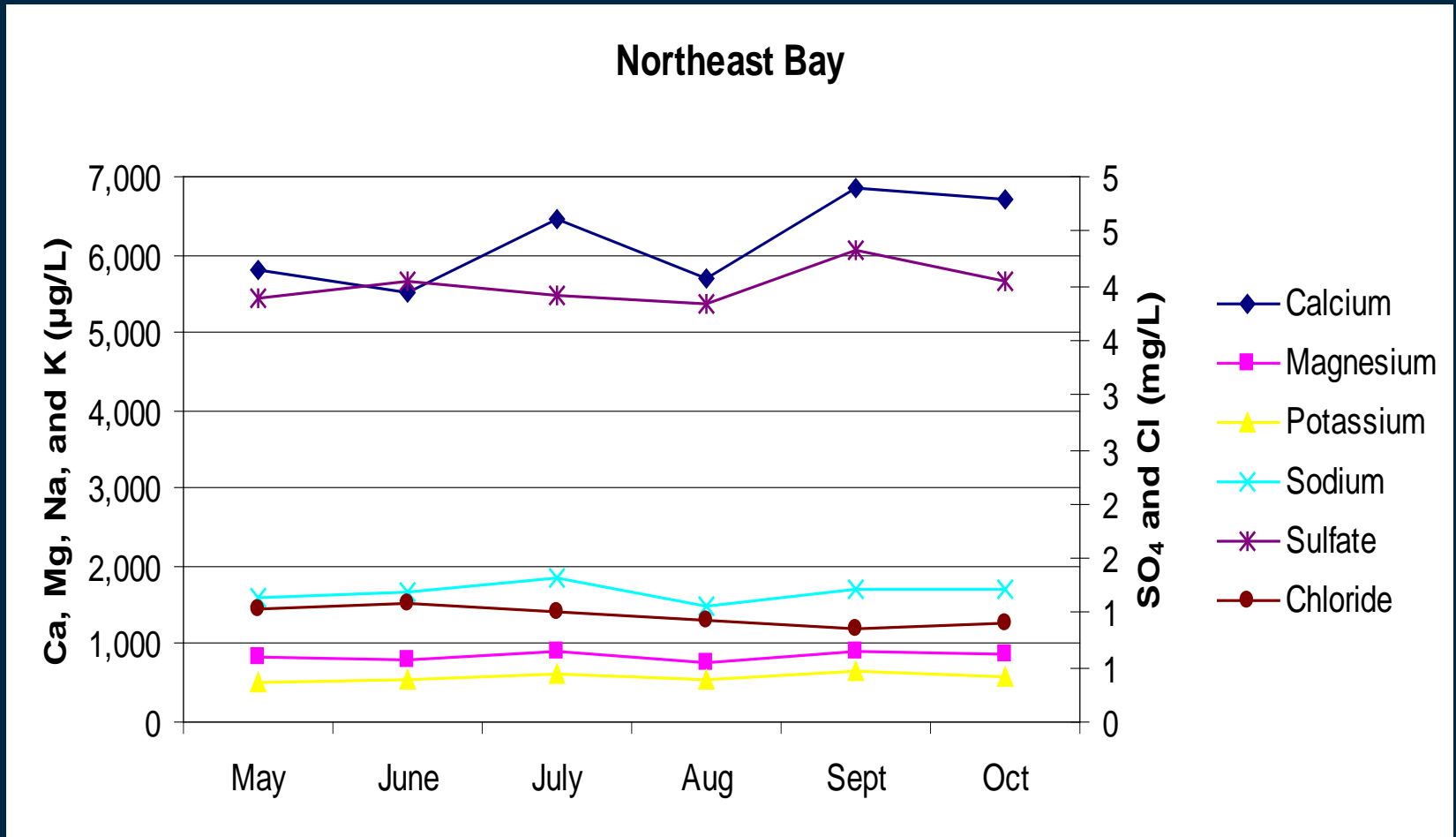
# Median Nitrate + Nitrite 2005 and 2007



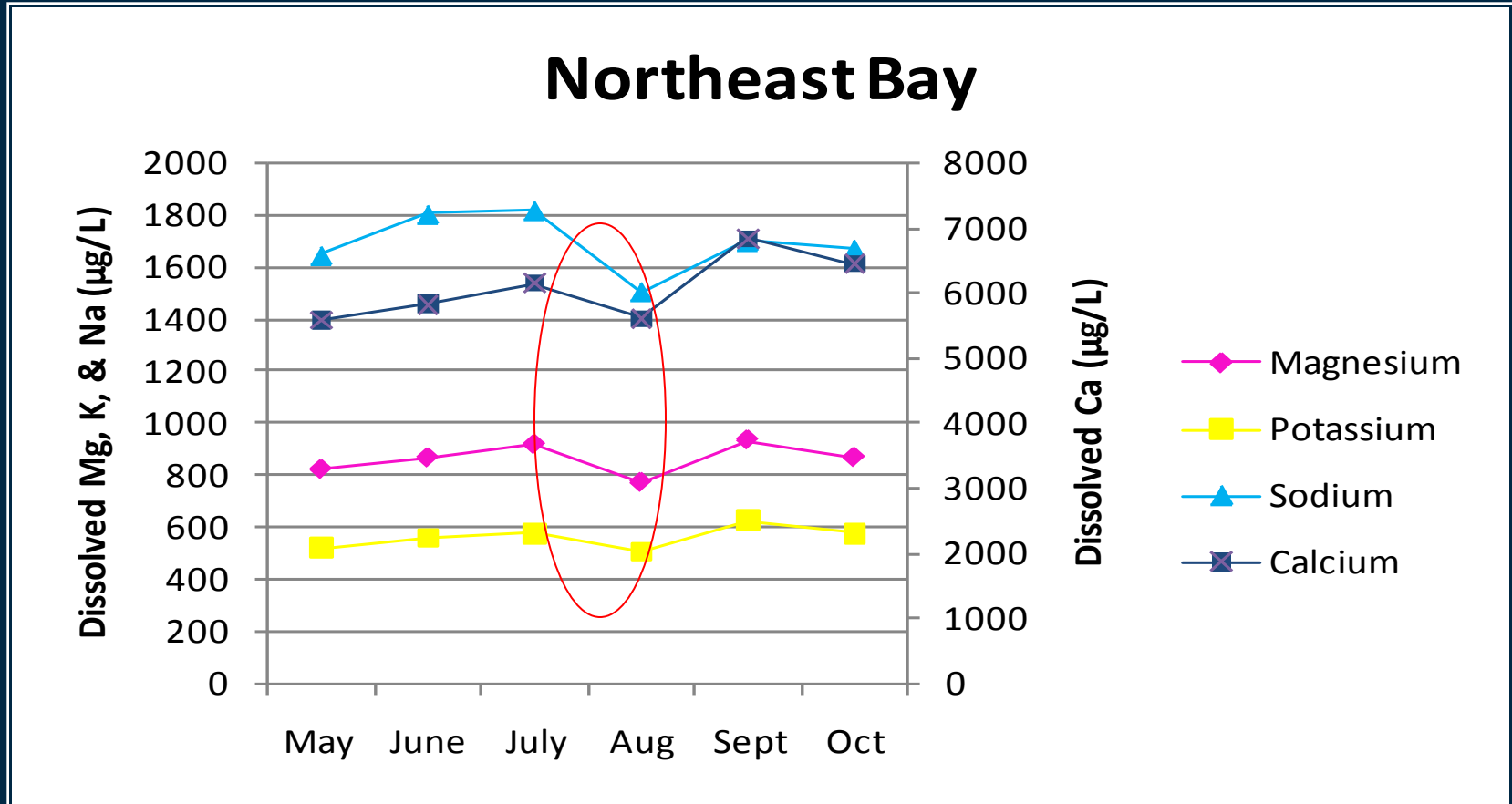
# Median TDS 2005 and 2007



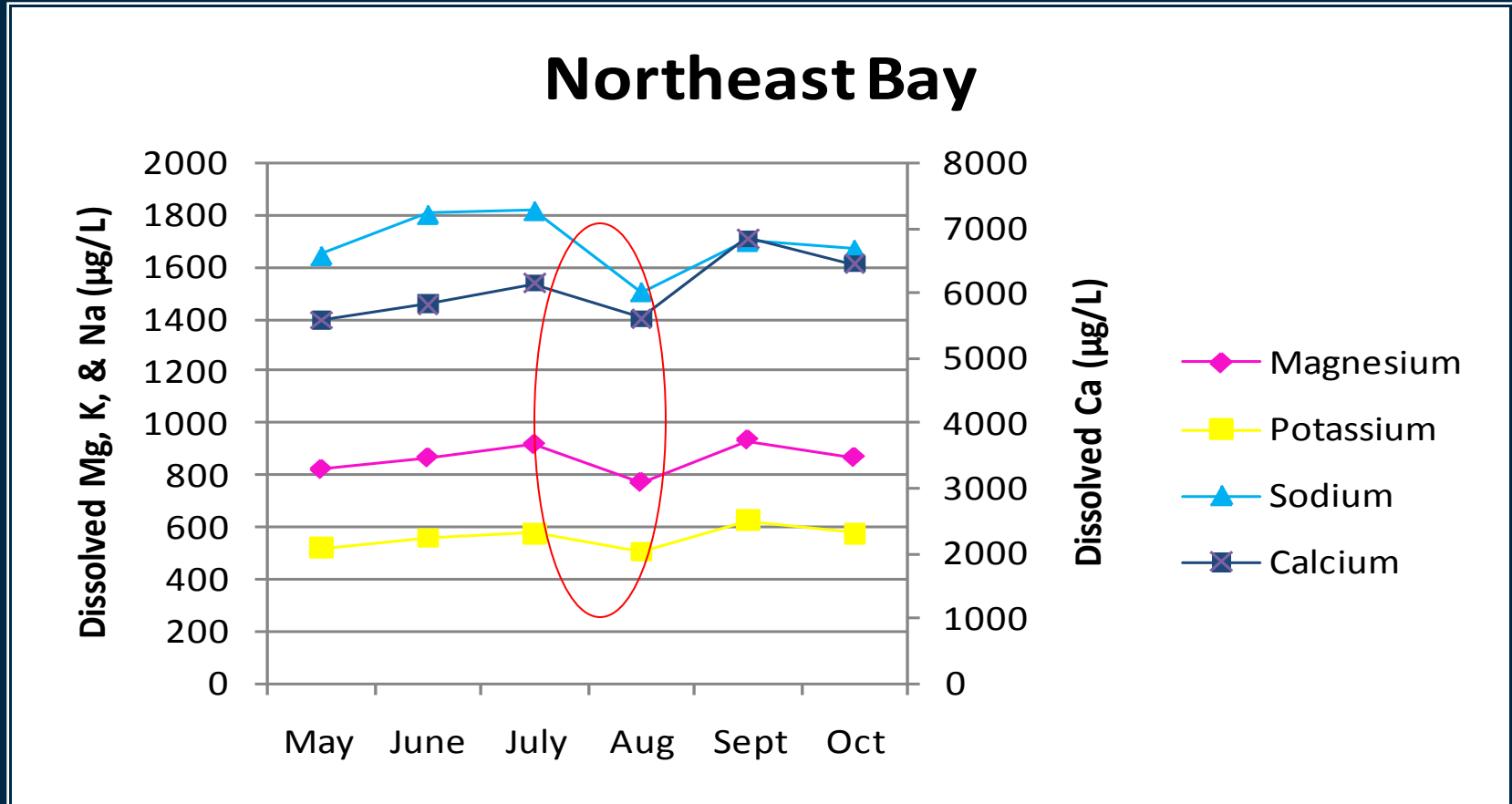
# Median Total Major Ions 2005 and 2007



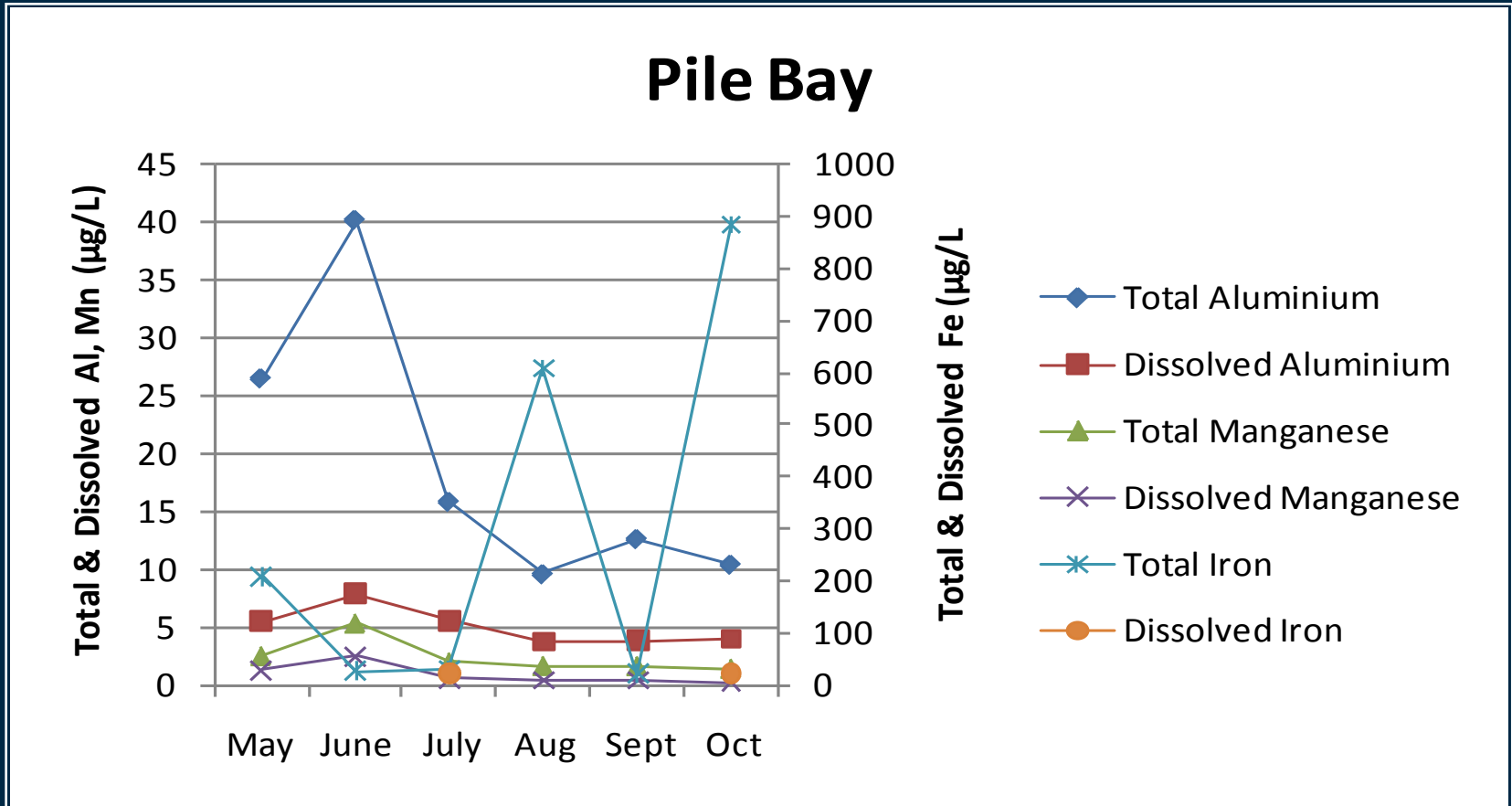
# Median Dissolved Ions 2005 and 2007



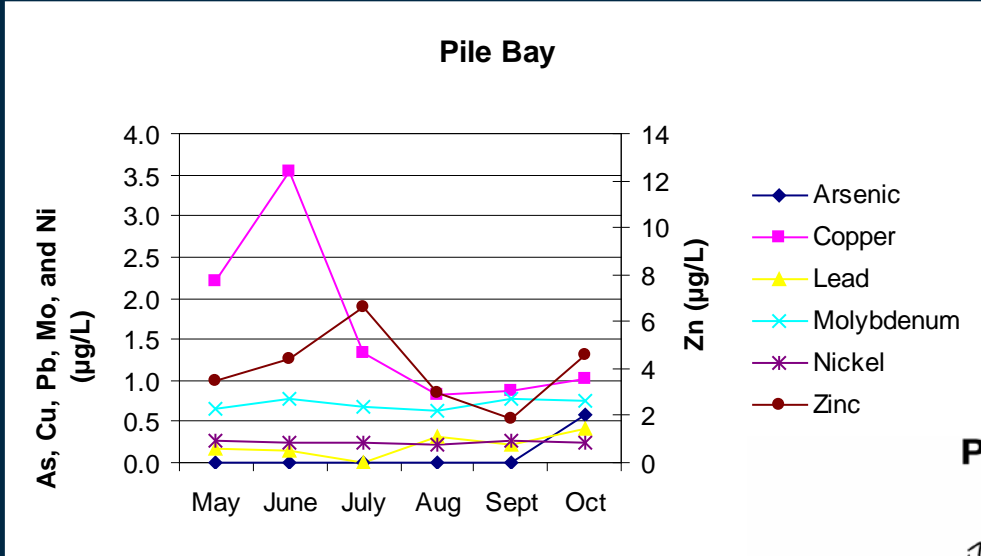
# Median Dissolved Ions 2005 and 2007



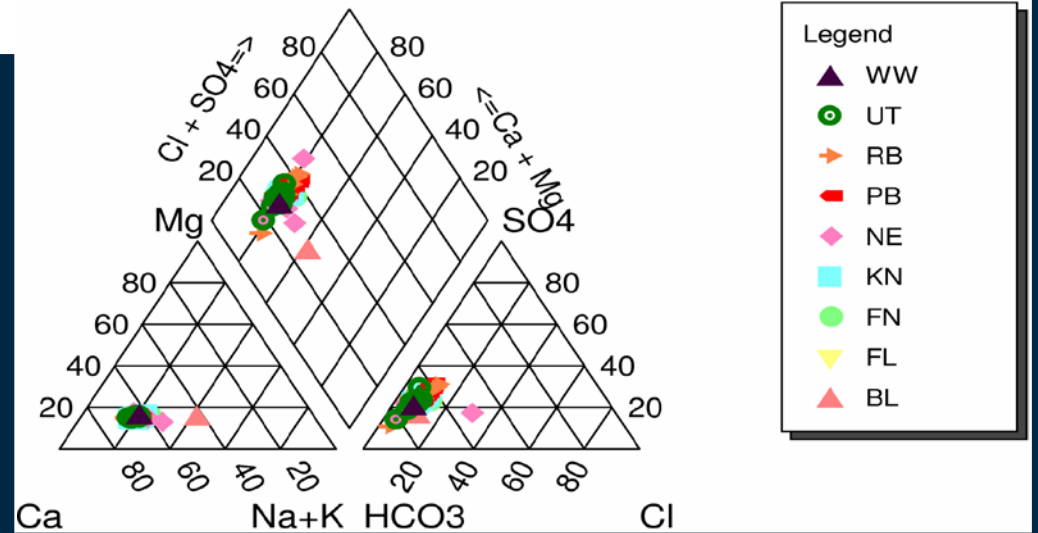
# Median Al, Fe, Mn; 2005 and 2007



# Piper Plot



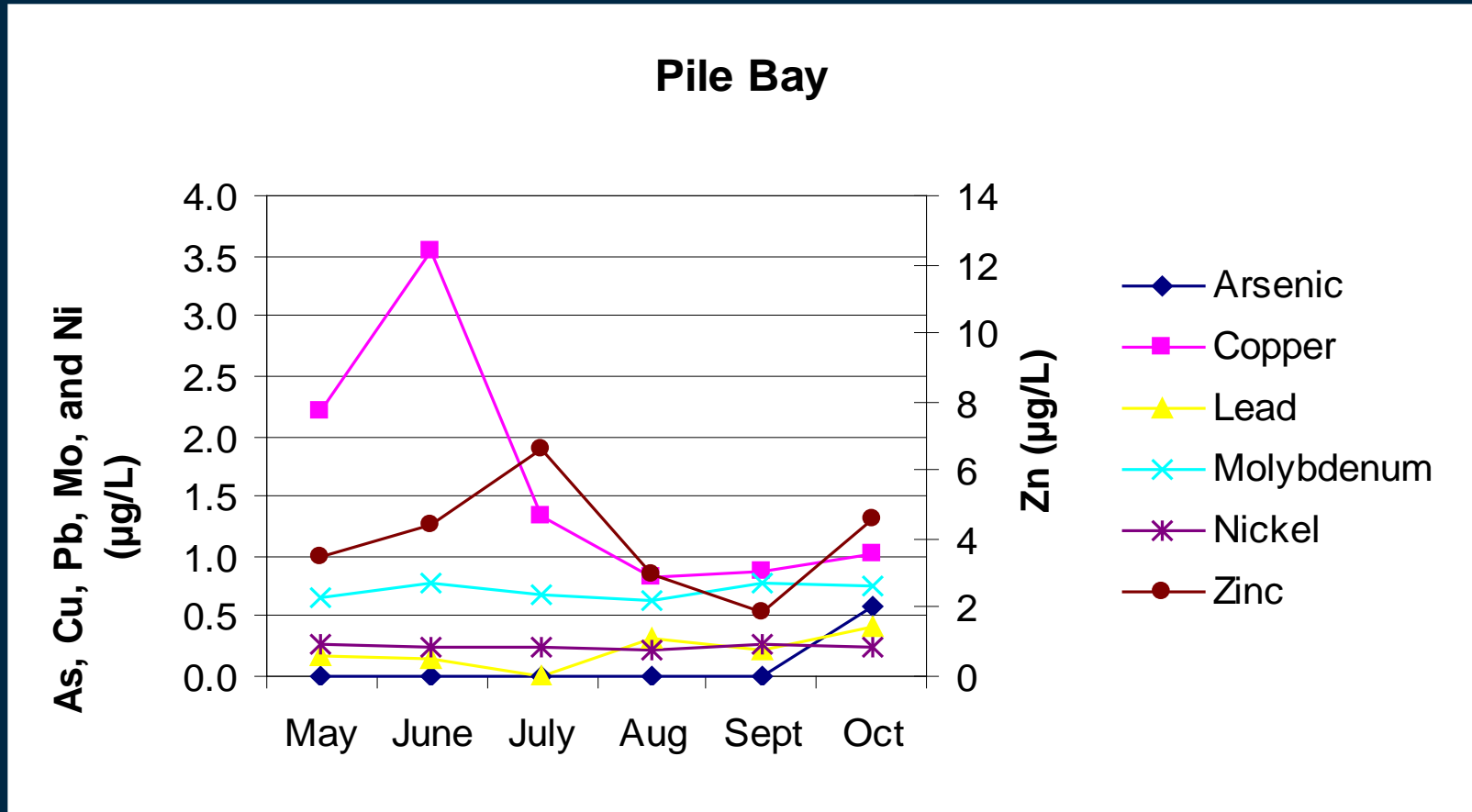
Piper Plot



Calcium Bicarbonate Waters



# Total Trace Elements 2005 and 2007

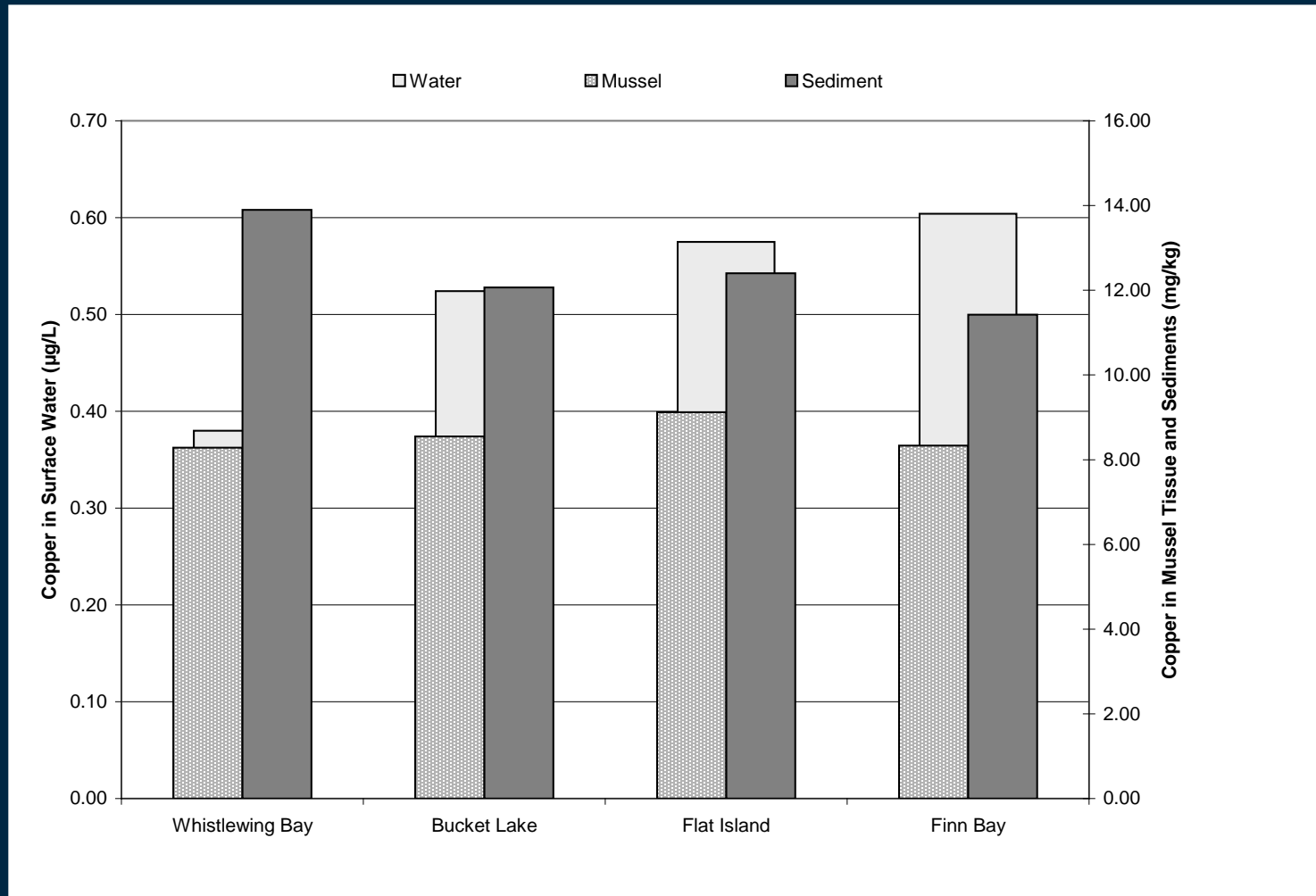


# Sediment and Mussel Results

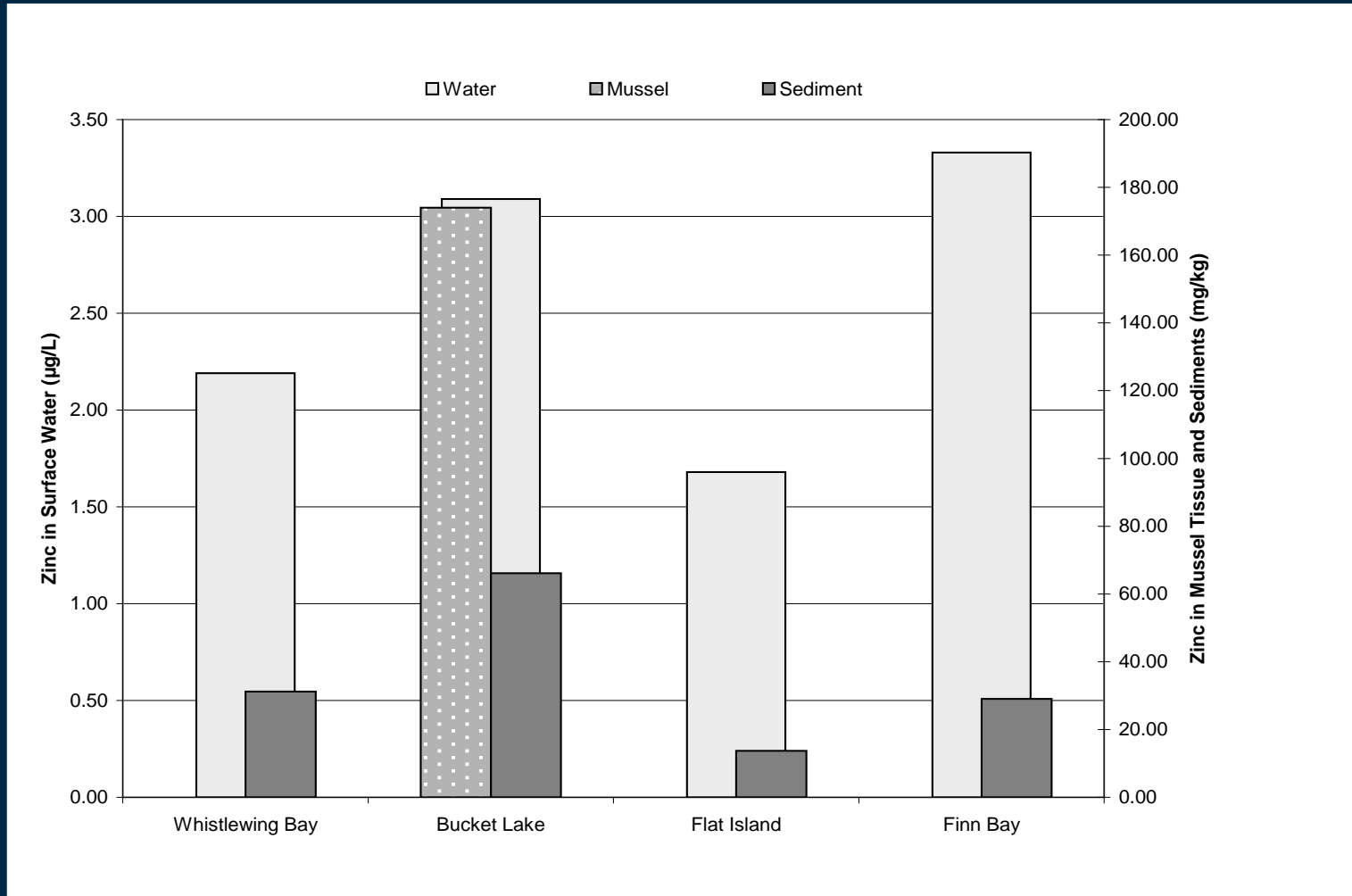
- Highest median concentrations of most metals tested in mussel tissue (except Nickel) found in Bucket Lake (Nickel = Finn Bay)
- Highest concentrations of lead and nickel in sediments found in Bucket Lake
- Mercury in mussels ranged from 0.053 to 0.282 mg/kg; the highest concentration was found at Bucket Lake
- No mercury detected (or below MRL) in water and sediments
- Organic constituents in mussel tissues were below MRLs
- RROs above the MRL in sediments at Bucket Lake, Flat Island, and Finn Bay
- PAH organics above MRL in sediments at Bucket Lake



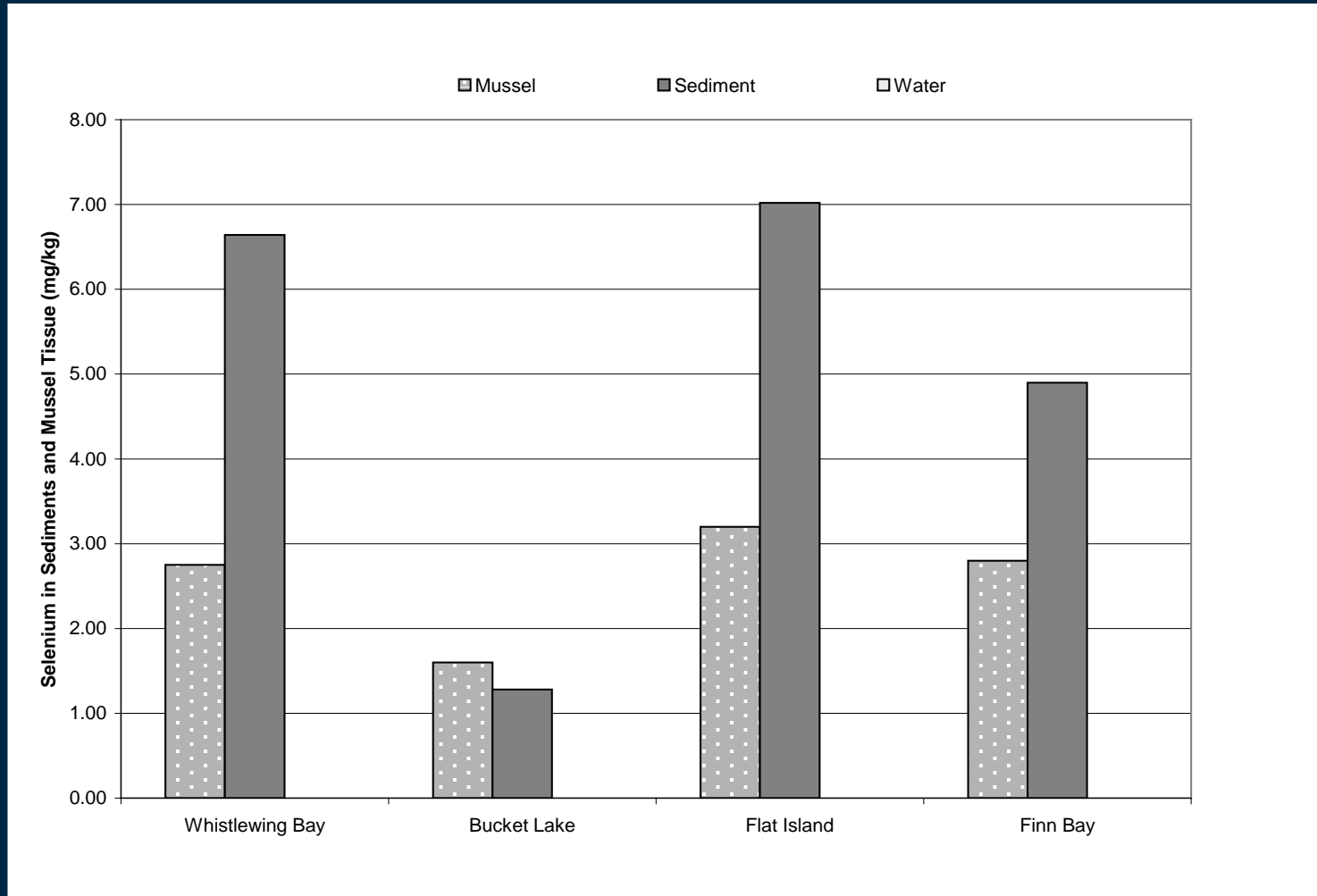
# Cu Sediment, Mussel and Water Results



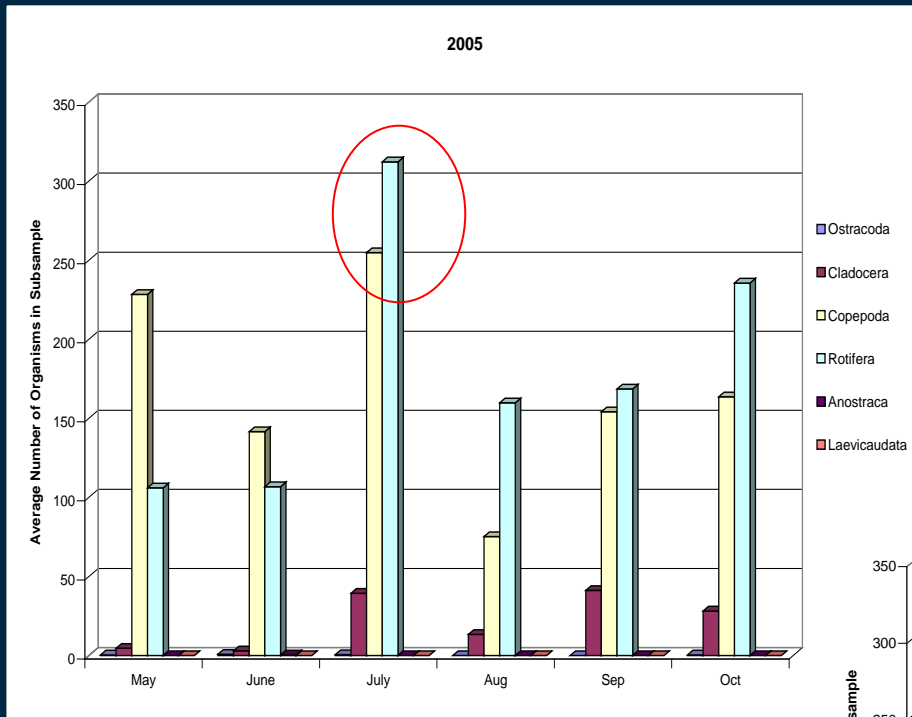
# Zn Sediment, Mussel, Water Results



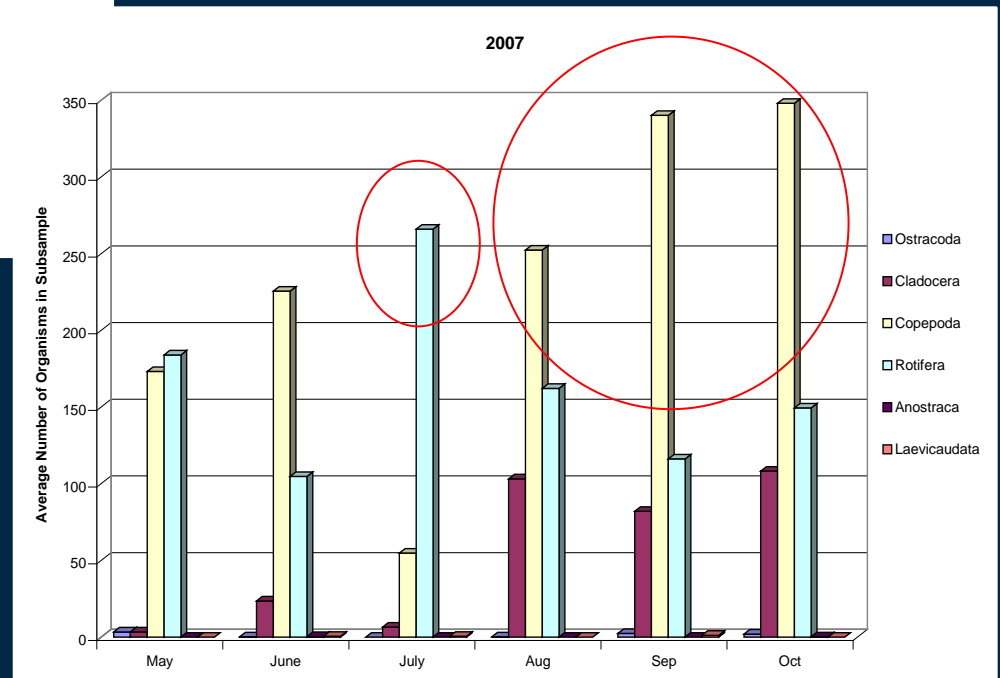
# Se Sediment, Mussel, Water Results



# Zooplankton Taxa 2005 and 2007

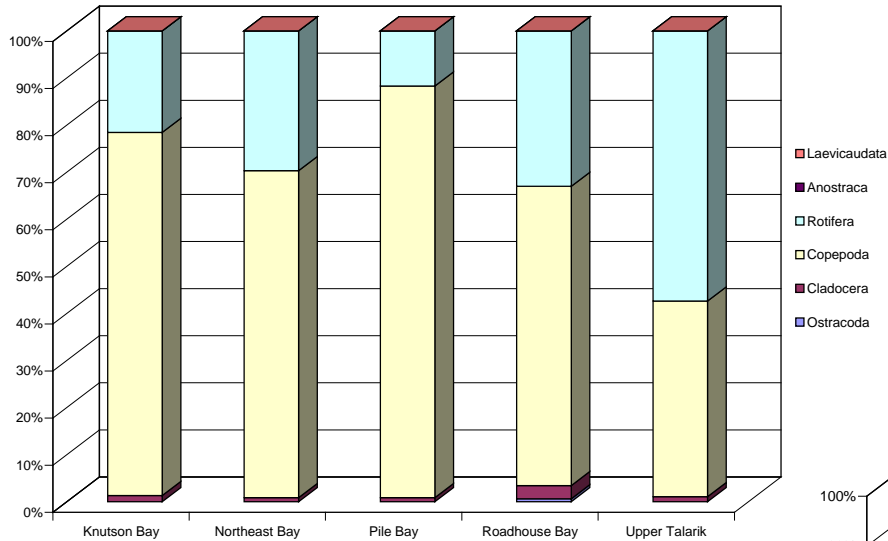


Cladocerans increase later in summer



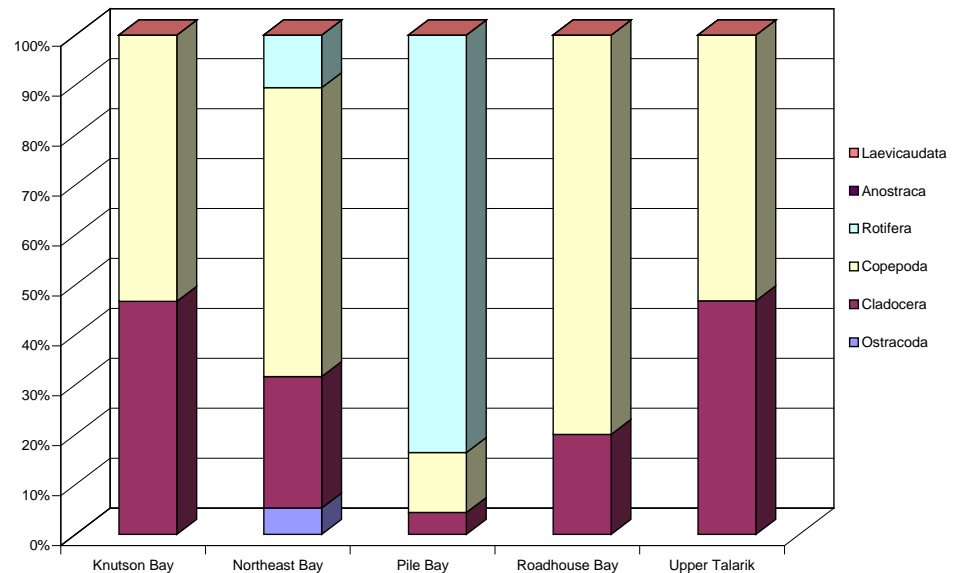
# Zooplankton Taxa 2005

May 2005



Cladocerans increase later in summer; same trend in 2007

October 2005



# Thank you



Brent Fenty

Erin Cunningham

Jessica Manifold

Dawn LoBaugh

Andra Love

Kelly Melillo

Rebecca Moore

Sally Morsell

Lynn Spencer

Isaac Watkins

John Baechler

John Baechler Jr.

Robert Bennett Smith

Shaw Alaska