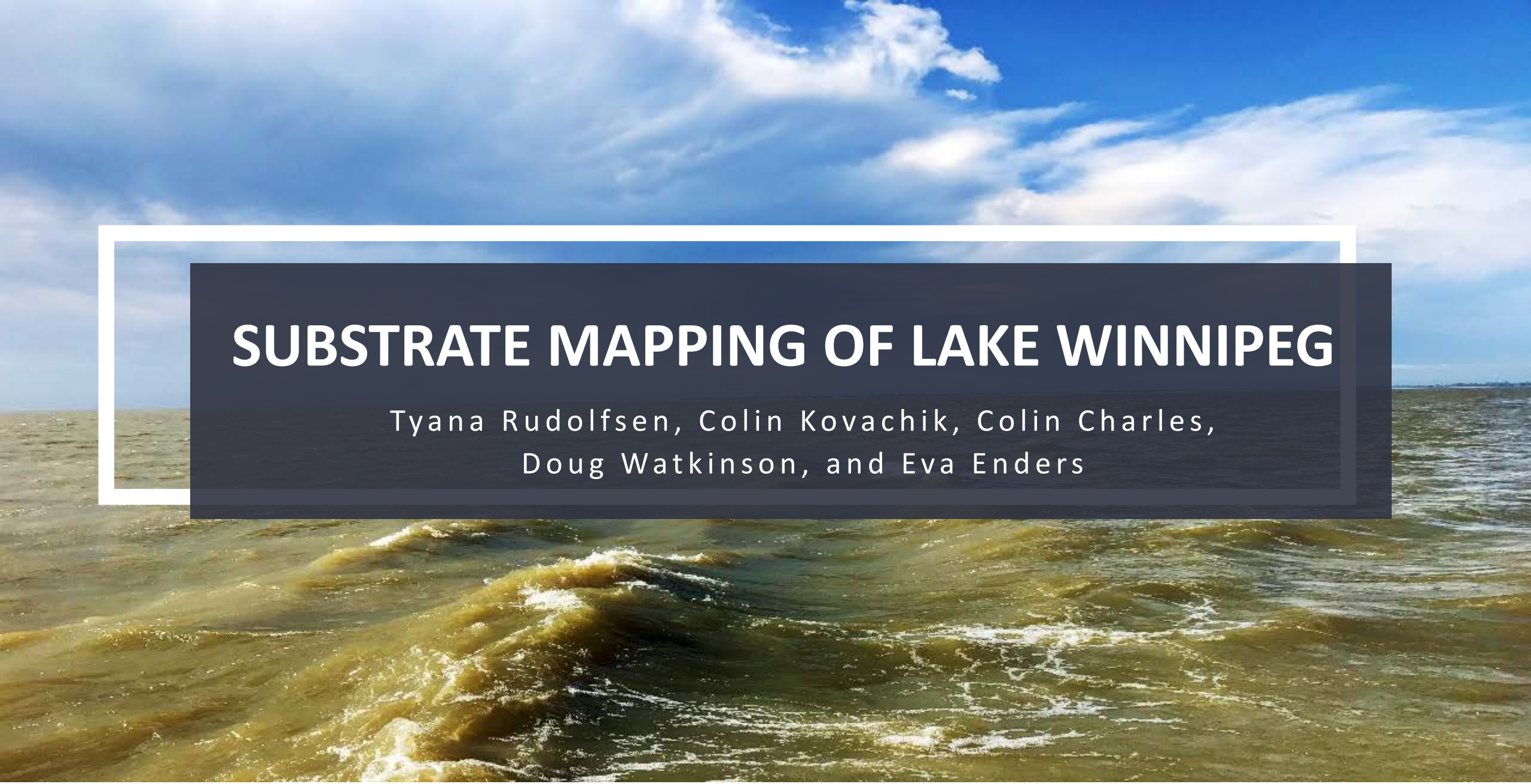


SUBSTRATE MAPPING OF LAKE WINNIPEG

Tyana Rudolfsen, Colin Kovachik, Colin Charles,
Doug Watkinson, and Eva Enders

Fisheries and Oceans Canada
Pêches et Océans Canada

BACKGROUND

LAKE WINNIPEG

- Boundary of interior plains and Canadian shield
- 23,750 km^2 and 436 km long
- Av 12 m deep, 36 m max

Map produced by *Environment Canada*

BACKGROUND

LAKE WINNIPEG FISH SPECIES

Lake Sturgeon (*Acipenser fulvescens*)

Walleye (*Sander vitreus*)

Common Carp (*Cyprinus carpio*)

Freshwater Drum
(*Aplodinotus grunniens*)

Bigmouth Buffalo (*Ictiobus cyprinellus*)

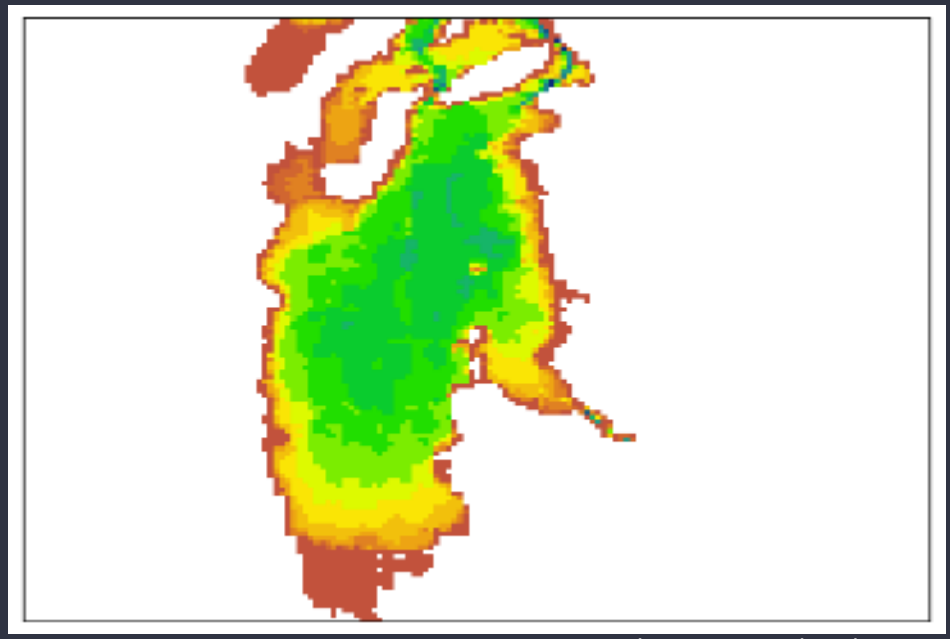
Channel Catfish (*Ictalurus punctatus*)

Images from *The Freshwater Fishes of Manitoba*, 2004

BACKGROUND

BATHYMETRY OF LAKE WINNIPEG

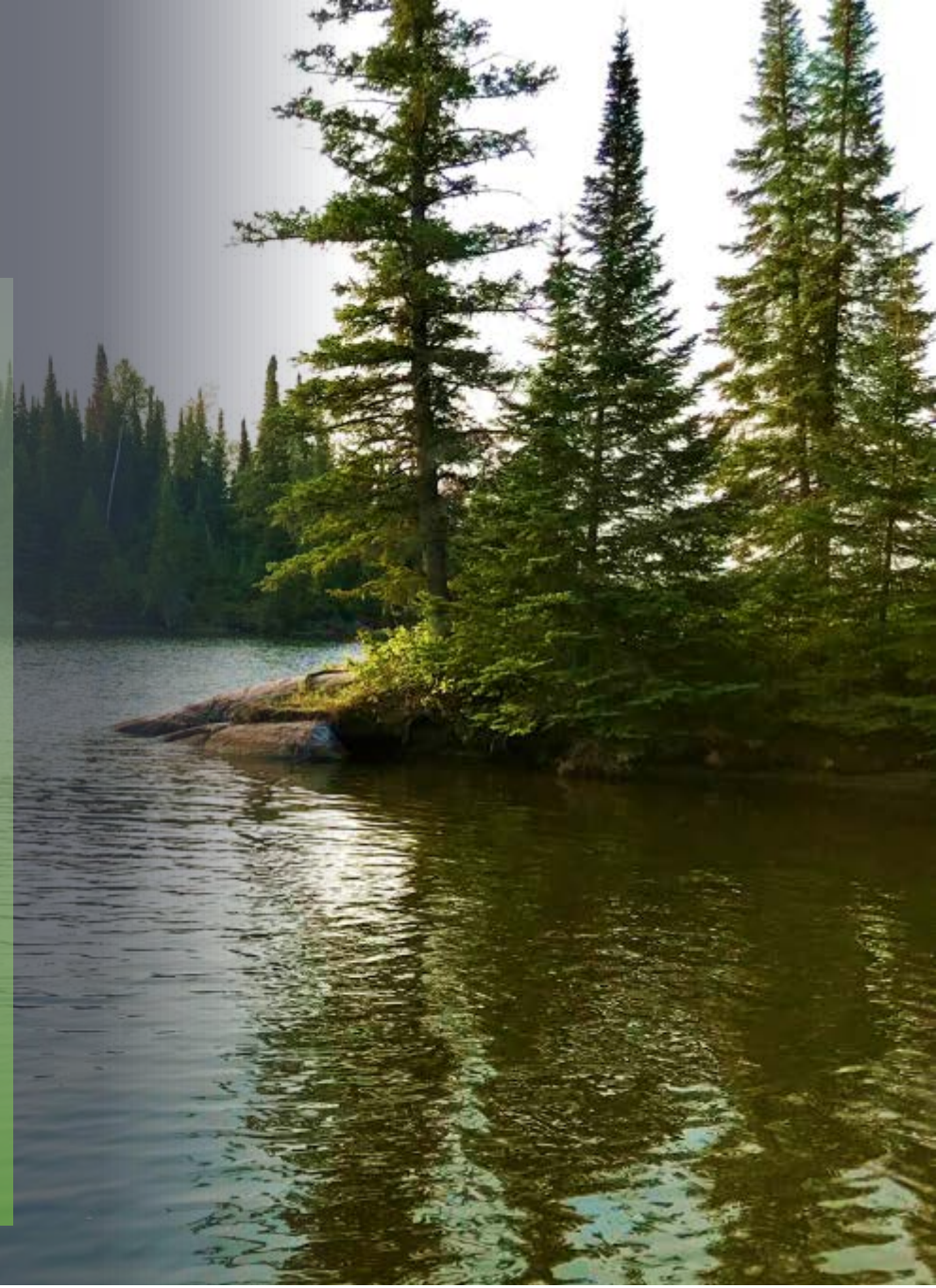
- Originally surveyed 1901-1904 and 1974
- No extensive substrate data available



Data author Ram Yerubandi, 2017

STUDY PURPOSE

1. Nutrient cycling modelling (ECCC)
2. Benthic invertebrate sampling program (LWRC)
3. Zebra Mussel colonization assessment (Manitoba Sustainable Development)
4. Establish linkages between fish movement patterns and habitat availability (DFO)



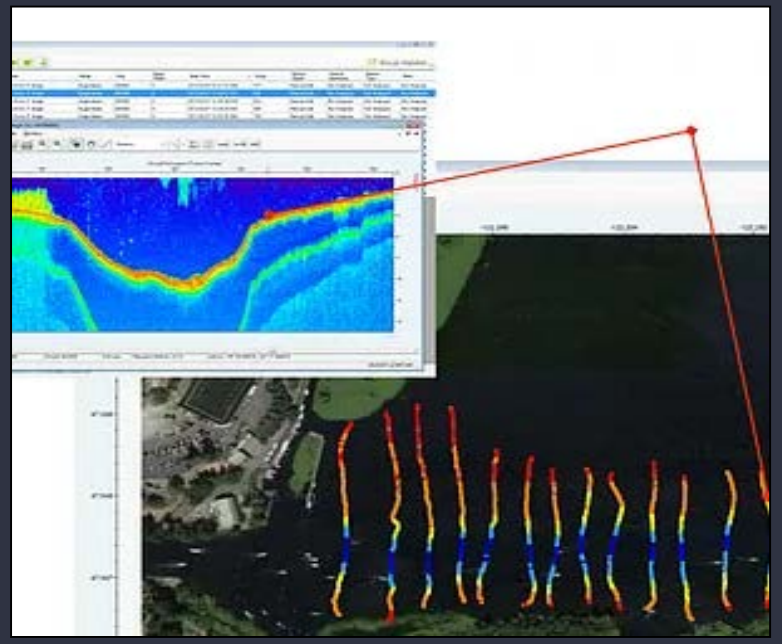
METHODS

1. SONAR TECHNOLOGY
2. SUBSTRATE SAMPLING
3. FISH TELEMETRY

METHODS

1. SONAR TECHNOLOGY

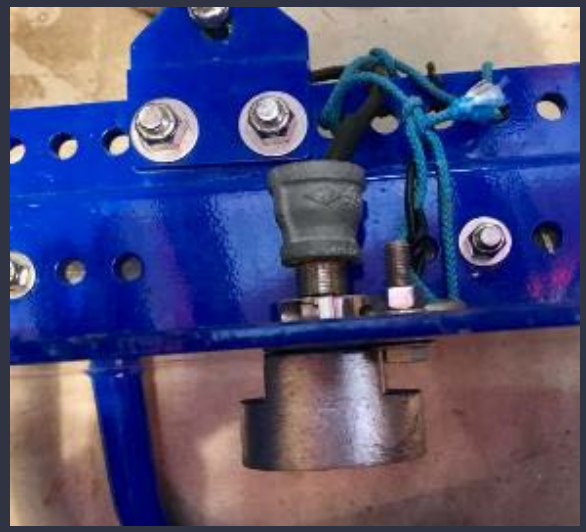
- Biosonics MX Visual Habitat Echosounder
- 200 kHz single conical beam
- Linear bathymetric profile



METHODS

1. SONAR TECHNOLOGY

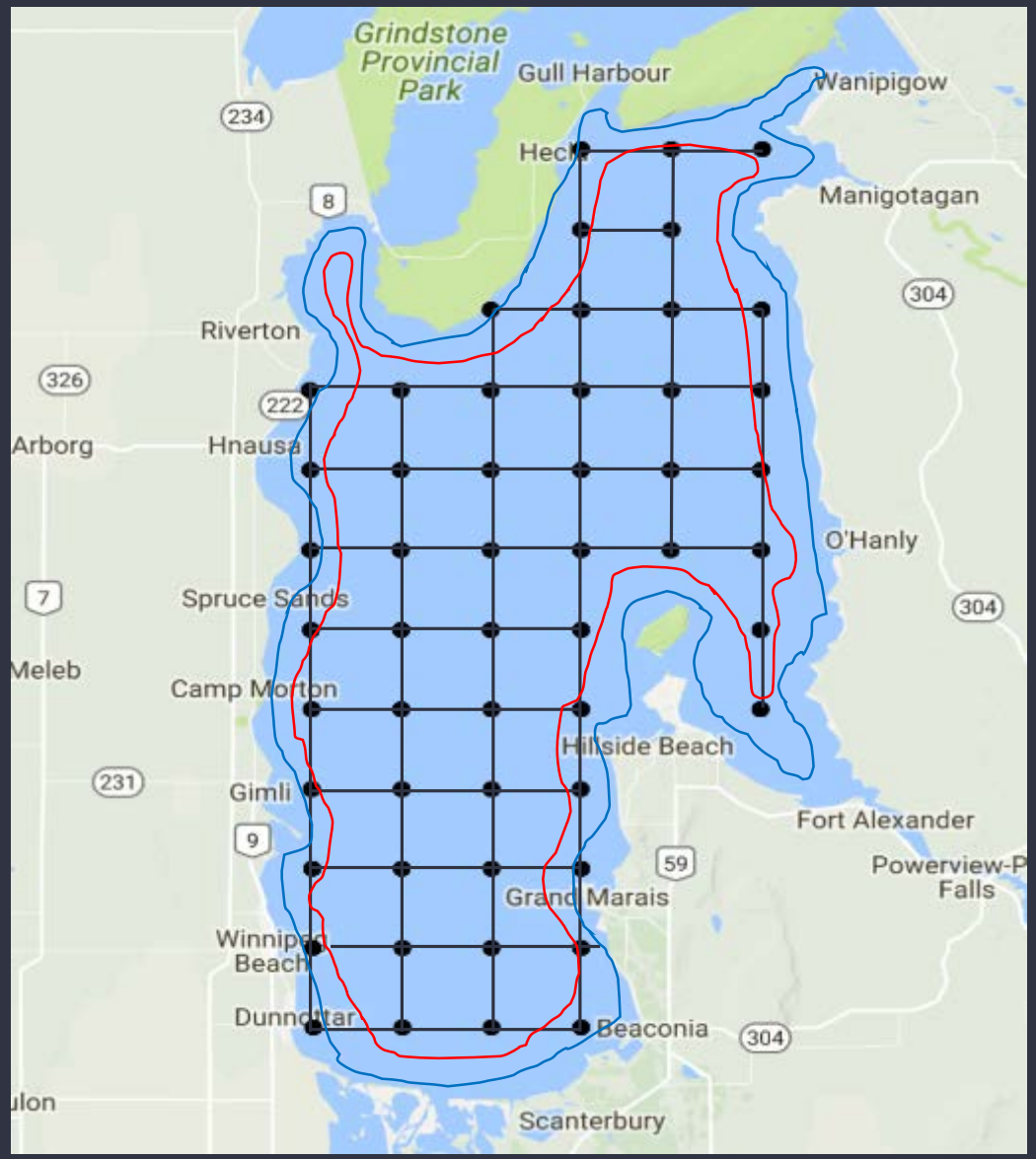
- Transducer mounted to underside of tow body
- Mobile deployment from small research vessel



METHODS

2. SUBSTRATE SAMPLING

- Ponar Grab
- Samples bagged for particle size analysis
- Malvern Mastersizer 3000



METHODS

SAMPLE LAYOUT

- Ponar grabs at each station
- Survey stations on a 7 km grid
- 3 and 6 m contours

METHODS

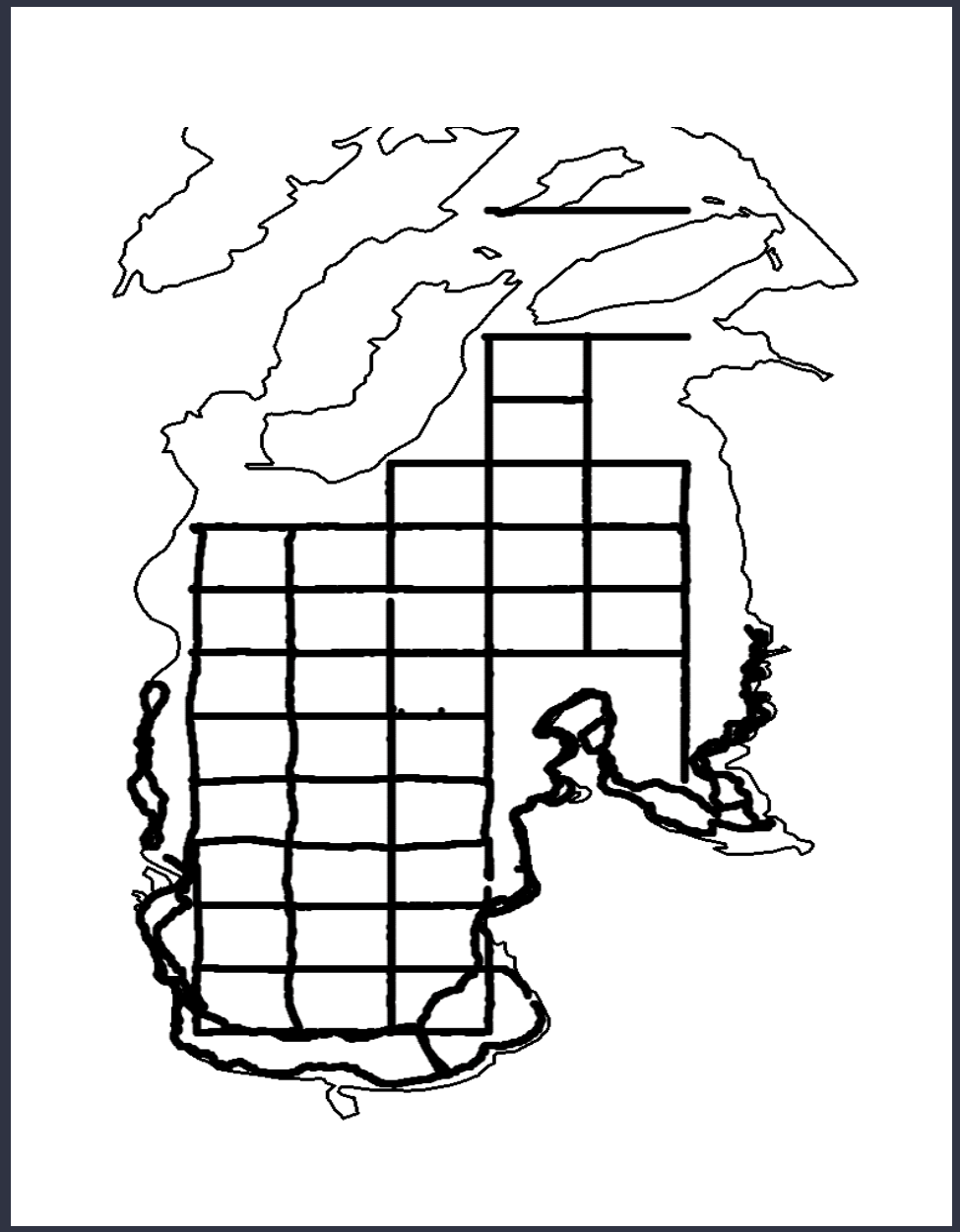
3. FISH TELEMETRY

- 760 Vemco transmitter tags
- 133 Vemco Receivers
- 2016 to present

METHODS

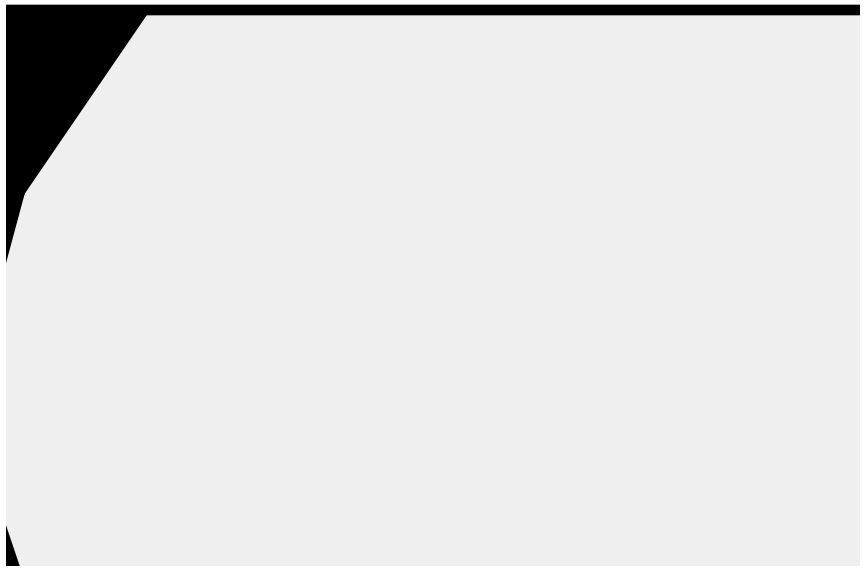
ANALYSIS

- **Bathymetry**
  - ArcMap - neighborhood interpolation
- **Particle Size**
  - Cluster Analyses
    - Elbow Method
    - Silhouette Method
    - K-means Clustering
- **Substrate Type**
  - Visual Habitat – substrate type
  - ArcMap - neighborhood interpolation



RESULTS

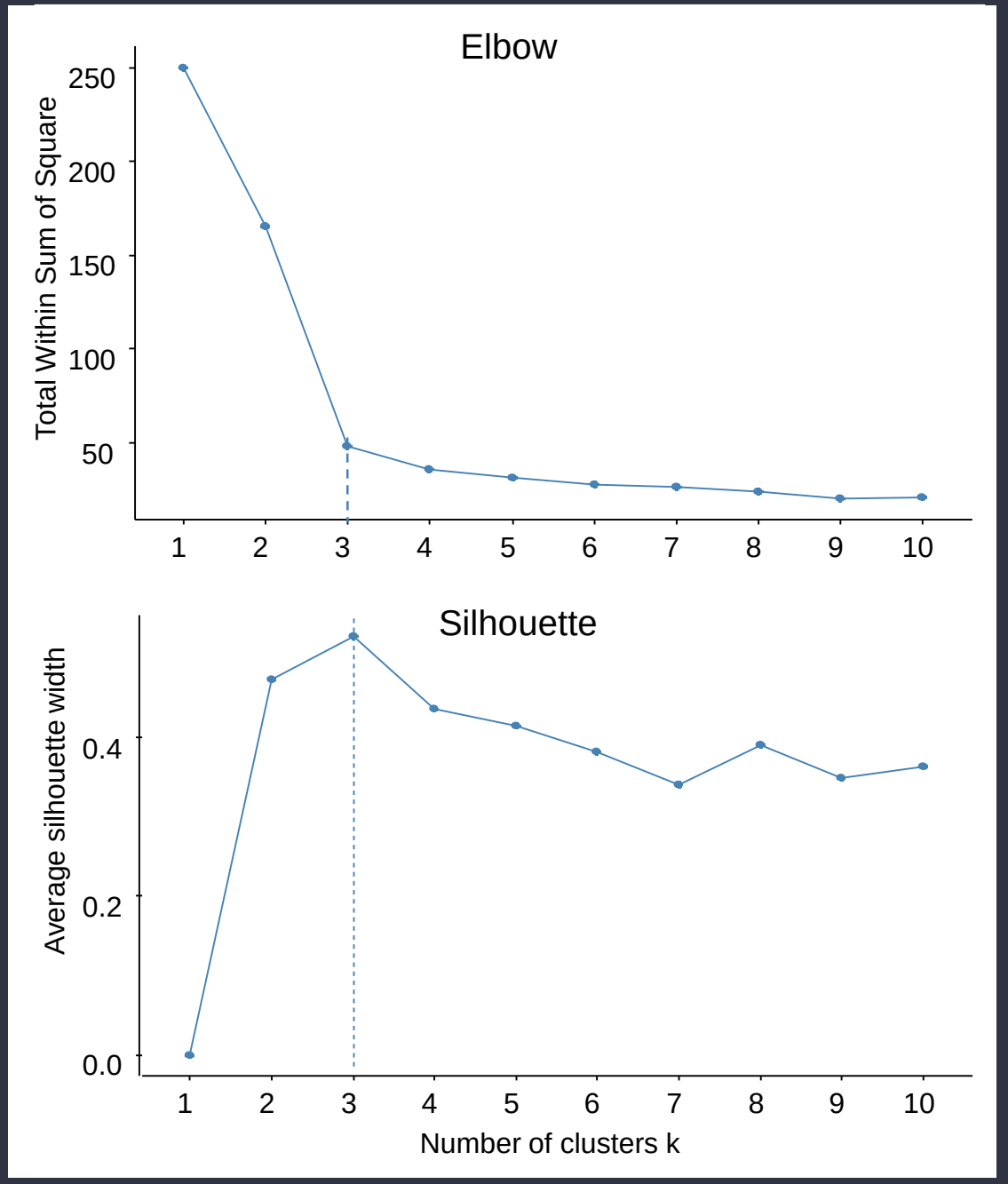
BATHYMETRY



RESULTS

CLUSTER ANALYSIS

- Elbow Method
  - Optimally small value of k that still has low SSE
- Silhouette Method
  - Measures how close each point in a cluster is to the points in neighboring clusters



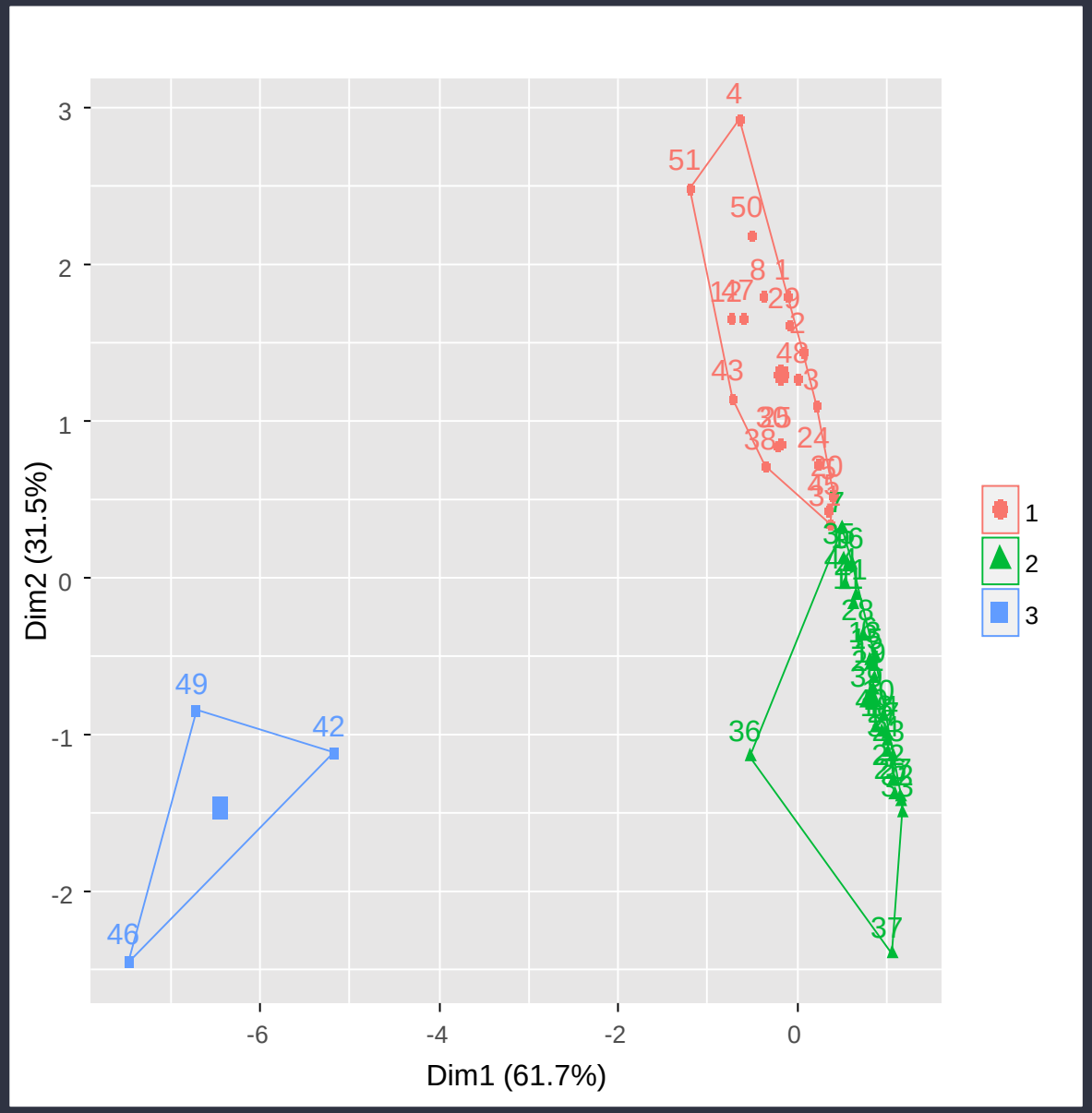
RESULTS

CLUSTER ANALYSIS

K-means clustering

25 iterations

3 groups



RESULTS

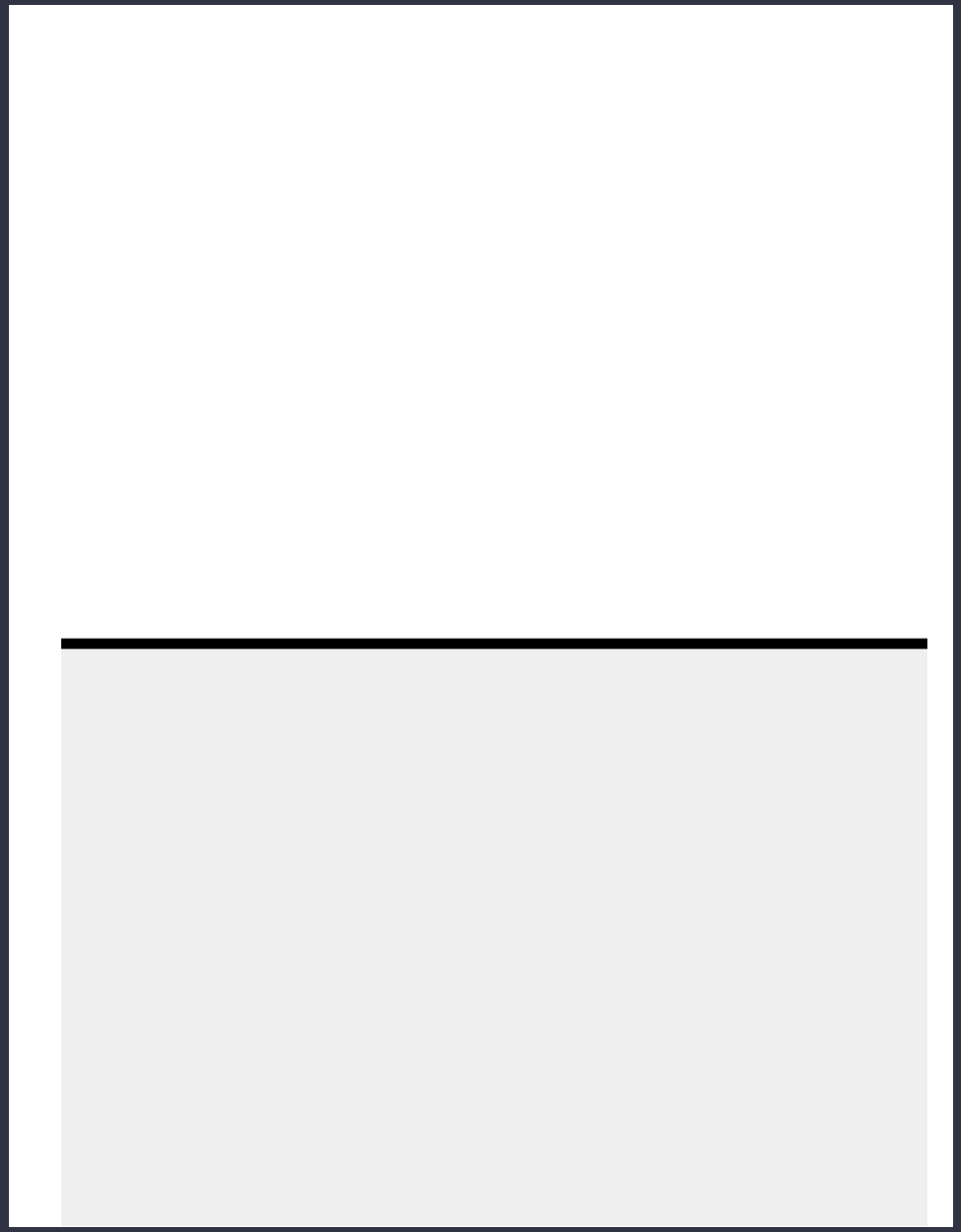
SUBSTRATE TYPE

CLUSTER	GRAVEL	SAND	SILT	CLAY	COLLOID	CLASSIFICATION
1	0%	4.9%	54.7%	29.4%	11.0%	High Silt / Low Clay
2	0%	2.6%	36.8%	43.0%	17.5%	High Clay / Low Silt
3	8.4%	69.9%	8.5%	8.5%	4.1%	Sand / Gravel

Average proportion of particle sizes from ponar grabs

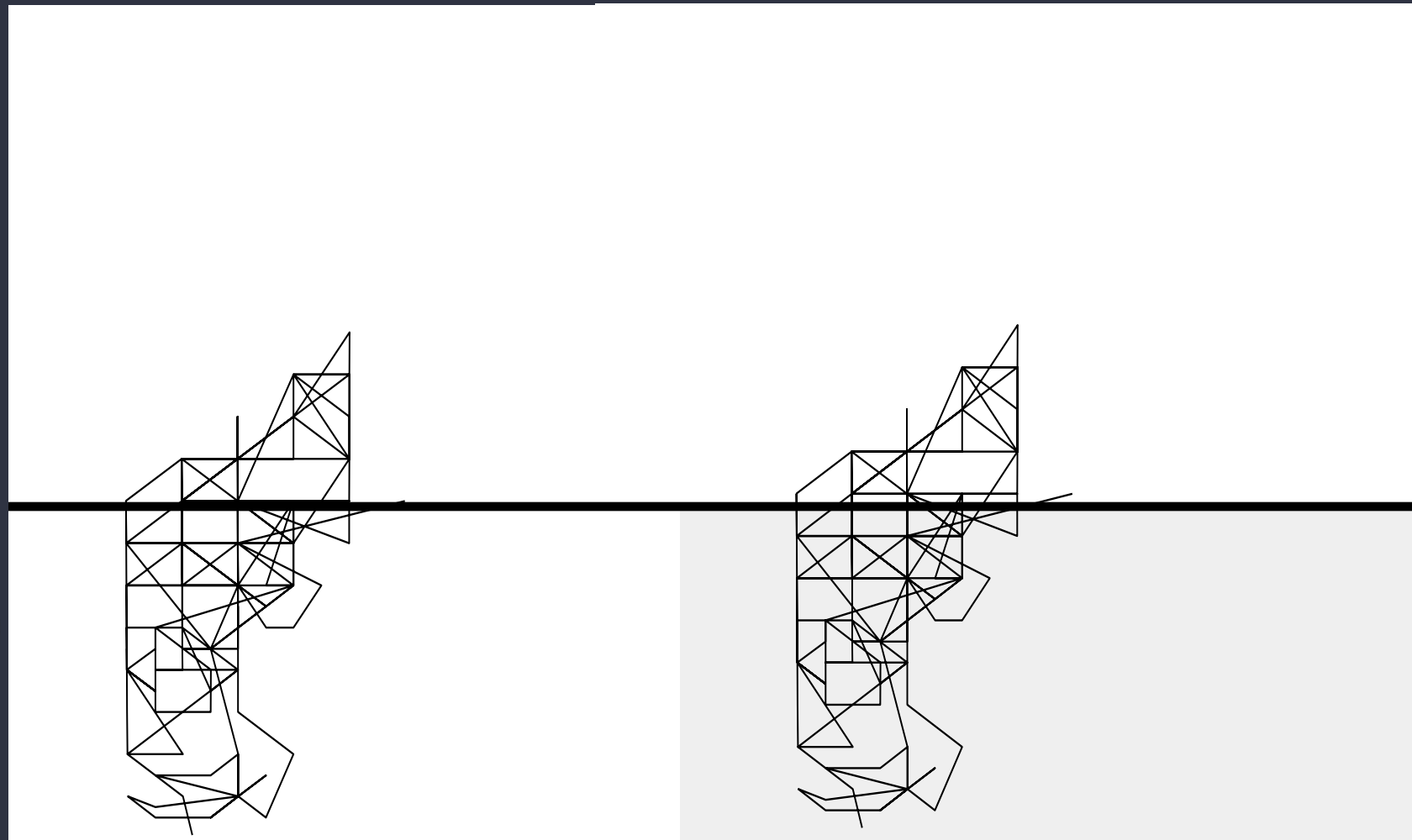
RESULTS

SUBSTRATE TYPE



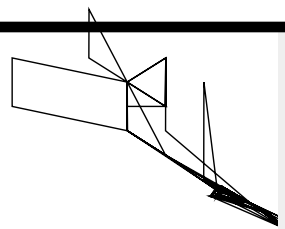
RESULTS

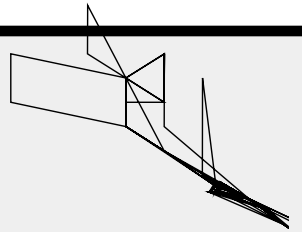
WALLEYE MOVEMENT



RESULTS

LAKE STURGEON MOVEMENT





FUTURE DIRECTIONS

Improved nearshore resolution

Narrows and North Basin

Long-term fish movement

Apply in fish management and research

FIN

RESEARCH PARTNERS

University of Manitoba

University of Nebraska Lincoln

LWF Lake Winnipeg Foundation

Department of Natural Resources

Lake Winnipeg Research Consortium Inc.

North Dakota Game and Fish

Fisheries and Oceans Canada / Pêches et Océans Canada

Environment and Climate Change Canada / Environnement et Changement climatique Canada

Lakehead University

Manitoba