Dissolved Oxygen and Fish & Wildlife Habitat in Gravel Pit Ponds

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Research Questions

- Is there a difference in dissolved oxygen concentrations between the 6 gravel pit ponds?
- Can the ponds support fish and wildlife during winter?

Introduction

- Gravel pits were constructed in Aniak, Alaska, during the early 1990s with additional pits added in 2018 for airport runway construction. Since excavation, these pits have been filled with water and are connected to the Kuskokwim River through a channel.
- The gravel pit acts as a bottleneck after river break up, trapping fish that can't contribute to the overall population when water levels are low.
- During our bird watching field activity last September 15, 2023, we observed ravens, grouse, ducks and geese around the ponds. It seems that the gravel pit ponds support both resident and migratory birds during spring and fall.
- Aniak residents have reported catching pike, spotting beavers, and observing nesting waterfowls in the gravel pit ponds, but no effort has been made to evaluate the efficacy of the gravel pit as a habitat for fish and wildlife.
- Our objective is to collect GLOBE water quality data (temperature, pH, dissolved oxygen, and conductivity) in 6 gravel pit ponds and develop baseline data for a potential restoration initiative. For this study, we analyzed dissolved oxygen differences across the ponds under the ice in winter.

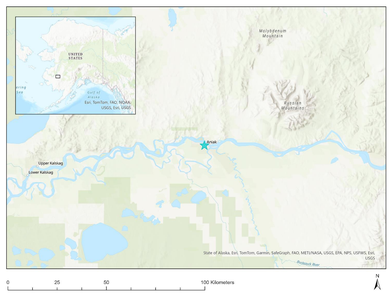

Figure 1.Aniak location map.
Generated by: Emily Sousa

Figure 2.Satellite image of the study site. **A,B,C,D,E,F** represents the gravel pit ponds.
Retrieved by: Dan Gillikan

Hypothesis

- Ponds with greater surface area will have higher dissolved oxygen concentrations.

Research Methods

- GLOBE Hydrology Protocols were utilized.
- Land cover data was obtained through GLOBE Observer App.
- Snow cover measurements were conducted at a location where snow drift does not occur.
- Utilized an ice auger to drill a hole in the pond and measured ice thickness, water depth, and total depth.
- YSI ProQuatro probe was deployed to collect water quality samples, measuring temperature, pH, conductivity, and dissolved oxygen. We conducted 3 trials midway and 3 trials at the bottom at each of the ponds. (See the pond depth and surface area measurements in ***Table 1***).

Pond	Midway Depth	Bottom Depth	Surface Area
A	100 cm	200 cm	23340 m²
B	90 cm	180 cm	13064 m²
C	150 cm	290 cm	40272 m²
D	145 cm	185 cm	23392 m²
E	45 cm	90 cm	14563 m²
F	175 cm	340 cm	96640 m²

- For our data analysis, we used Google Earth to determine the surface area of each ponds.
- Generated a scatter plot correlating midwater dissolved oxygen levels with surface area to test our hypothesis.
- Generated a graph to visualize the standard error of the average midwater dissolved oxygen levels within each pond.

Fig.3 YSI ProQuatro probe

Fig.4 Drilling a hole in the ice

Fig.5 Jack and Ralph deploying the probe

Fig.6 The whole group collecting water quality data

Results

- Dissolved oxygen levels near the bottom of the ponds were low during winter, but Pond A and Pond F shows potential levels for sustaining fish near the midway.

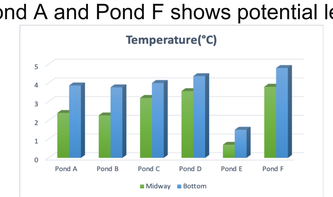

Figure 7. Average temperature for each site

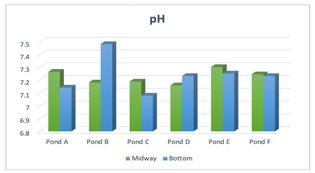

Figure 8. Average pH for each site

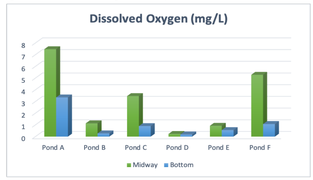

Figure 9. Average dissolved oxygen levels for each site

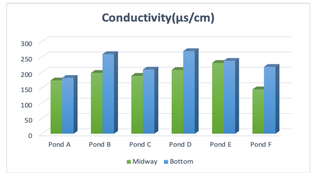

Figure 10. Average conductivity for each site

Discussion

- Dissolved oxygen with a minimum of 5mg/L can generally support fish and other aquatic organisms (Herricks,1982).
- The midway dissolved oxygen levels observed in Pond A and Pond F may be due to the fact that they are more recent ponds compared to Ponds D,C,E. The older ponds have accumulated more organic matter and nutrients over time, which can led to oxygen consumption as they break down, affecting dissolved oxygen levels.
- The ponds were completely frozen over and had been since early December and presumably at their lowest levels during our data collection. Low levels of dissolved oxygen were detected in all ponds near the bottom during winter. This findings yielded the same outcomes with Bryant (1988) who investigated gravel pit ponds as habitat for coho salmon.
- The correlation graph indicates weak relationship between midway dissolved oxygen levels and surface area (See ***Figure 11***). This weak correlation results from high dissolved oxygen readings from Pond A, which are considered outliers in our dataset. This can be explained by the greater inflow Pond A receives due to the river bend. This suggests for further investigation, specifically comparing the water quality between the river and Pond A for the next data collection.
- The graph displaying the standard error of average midway dissolved oxygen levels indicates that the data collected from Pond B and Pond C were more spread out compared to the other ponds. This is evidenced by the longer standard error bars as shown in ***Figure 12***. This could be due to the different students involved in deploying the probe, indicating an implementation issue. This serves as a valuable factor for our future data collection.
- Our investigation can further be improved if we collected data before freeze-up and after break-up to assess overwinter use of ponds and examine effects on water quality parameters during river flooding.

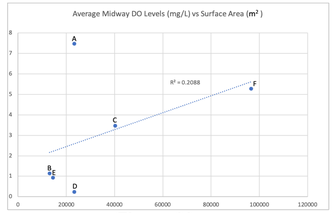

Figure 11

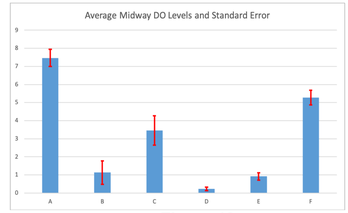

Figure 12

Conclusion

- Our results are inconclusive and requires further investigation regarding the reason for high dissolved oxygen levels in Pond A . The flow of groundwater into and out of the ponds could play an important factor determining water quality.
- Regular collection of water quality data can improve our understanding how these gravel pit ponds may transition into a more functioning ecosystem for fish and wildlife.
- Our next steps will align with Matter's (1988) claim, which states that disturbed land can be reclaimed to provide fish and wildlife habitat if water is present. By establishing baseline data through continued water quality monitoring, we can formulate management recommendations to enhance fish and wildlife habitat, create recreational and subsistence opportunities for the community and transform the area into a practical laboratory for students like us to better understand how ecosystems function.

References &Acknowledgement

- Bryant, Mason D.(1988). "Gravel Pit Ponds as Habitat Enhancement for Juvenile Coho Salmon". General Technical Report PNW-GTR-212.Portland,OR:U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.
- Matter, William J.(1988). "Sand and Gravel Pits as Fish and Wildlife Habitat in the Southwest". United States Department of Interior Fish and Wildlife Service, Resource Publication 171.

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