Effects of Airport Runoff Pollution on Water Quality in Bay Area Sites Surrounding San Francisco and Oakland Airports

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ABSTRACT

Airports contribute to pollution through point source and non point source pollution, which can have a negative effect on water quality and aquatic life. The purpose of the study was to determine if runoff pollution from SFO and OAK airports impacts water quality in the Bay Area. We tested water quality at 12 sites surrounding two airports in the Bay Area. We tested for pH and the presence of specific metals and nitrates. As a result of the analysis, we found that the presence of zinc, copper, chromium and nitrate increases as we get closer to the airport. The pH remained constant throughout the sites. We concluded that airport pollution is a likely source of elevated concentrations of some heavy metals and nitrates in the San Francisco Bay.

INTRODUCTION

Pollutants from airport runoff can contaminate nearby waters and have a negative impact on the local ecosystems. The EPA controls and authorizes airport discharge into water through point sources of pollution in an attempt to diminish negative effects on water quality (1). However, unregulated pollution can also reach bodies of water through runoff. This contaminated runoff can have a negative effect on surrounding water since it holds a lot of contaminants. Pollutants in surrounding water around airports can kill fish, cause algae blooms, and contaminate the waters (2).

Unrestricted airport pollutants can reach bodies of water through a few ways. They can reach surrounding bodies of water through non-point sources and runoff pollutants. Pollutants from jet leuel and construction, as well as other chemicals, can gather on runways and other surfaces and can be

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washed into surrounding bodies of water by storms (1) Runoff pollutants may include oils, greases, de-icing chemicals, jet fuel excess, and metals (1). Chromium, Zinc, and Copper are common metals found in airport runoff, as well as nitrates (3). An increase of Chromium in bodies of water can cause harm and even death to aquatic species, particularly fish (4). An excess of zinc in water can cause damage to the organs and tissues of aquatic animals and may even cause death (5). An excess of copper also causes damage to organs and systems, such as the nervous system and the immune system of aquatic animals. Eventually, toxic levels of copper in water can lead to the death of aquatic organisms (6). An excess presence of nitrate in a body of water can cause an excessive growth of algae. Excess growth of algae causes unstable amounts of dissolved oxygen, which causes stressful conditions for fish and other aquatic species and may cause them to die off (7). Airport runoff can also affect the pH of surrounding waters. When the pH of a body of water is either too high or too low, the aquatic organisms living in that water will die (8).

To determine the relationship between pollution from airports and surrounding waters, we tested whether water quality decreased near an airport. Surrounding areas near two airports were studied to see how airports might impact water pollution. We tested three sites north of each airport and three sites south of each airport. The two airports we tested were San Francisco International Airport and Oakland International Airport. We measured ph, hardness, and sampled for the presence of metals and nitrates to test the hypothesis that water quality would decrease as proximity to an airport increased. Data from both airports showed that the water quality decreased as we got closer to the airport, showing that pollution from airports impacts the surrounding waters.





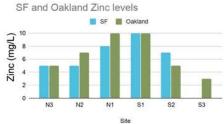
Figure 1: Sample location maps, map A is of SFO and surrounding sites I tested at. Map B is of OAK and sites I sampled surrounding it.

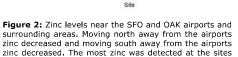
METHODS

closest to the airport.

I tested 12 sites by two airports, San Francisco International Airport and Oakland International Airport during July 4-5, 2020. I tested for pH and the presence of specific metals in three sites north of each airport and three sites south of each airport. To test pH, I immersed the VIVOSUN pH meter into the bay and waited until the reading stabilized. I then recorded the reading and cleared the pH meter

by cleaning with pure water and drying it. I then repeated this process two more times. I repeated this process to measure the precision of my results. To test the presence of specific metals, I took a test strip from the Ultimate Drinking Water Test Strips (life2O) and immersed it in the bay for two seconds. I then removed it from the water and waited 60 seconds. After the 60 seconds I recorded the results I then repeated this process once and compared my results to measure precision of the test strips.





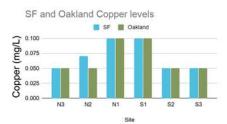


Figure 3: Copper levels near the SFO and OAK airports and surrounding areas. Moving north away from the airports copper decreased and moving south away from the airports copper decreased. The most copper was detected at the 2 sites closest to the airport.

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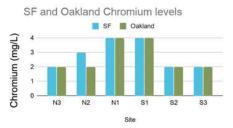


Figure 4: Chromium levels near the SFO and OAK airports and surrounding areas. Moving north away from the airports chromium decreased and moving south away from the airports chromium decreased. The most chromium was detected at the 2 sites closest to the airport.

RESULTS

The effect of airport pollution on water quality was tested through measuring parameters of water quality in sites surrounding airports. I tested three sites north and three sites south of two airports, San Francisco International Airport and Oakland International Airport (see figure 1).

I tested for pH and the presence of zinc, copper, chromium, and nitrate. I took multiple measurements at each site to assess the precision of my results. The levels of zinc in the water increased as we got closer to the airport (figure 2). The zinc levels were highest at the sites closest to the airport (N1 and S1), ranging from 8 to 10 mg/L, and lowest at the amounts of dissolved oxygen. Unstable amounts sites farthest from the airport (N3 and S3), ranging

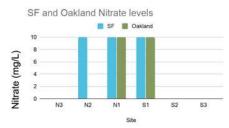


Figure 5: Nitrate levels near the SFO and OAK airports Figure 6: pH levels near the SFO and OAK airports and 2 sites closest to the airports and at the middle site north it was at the sites in San Francisco. of SFO.

from 3 to 5 mg/L. The levels of copper and chromium also increased near the airport (figures 3 and 4). The copper levels were highest at the sites closest to the airport (N1 and S1), at 0.1 mg/L. They were lowest at the sites farthest from the airport (N3 and S3), situated at 0.5 mg/L. The levels of chromium were highest at the sites closest to the airport (N1 and S1), at 4 mg/L. The levels were lowest at the sites farthest from the airport (N3 and S3), set at 2 mg/L. Nitrate was detected at the sites closest to the airport (10 mg/L), but was not detected at the sites farthest from the airport (figure 5). The pH levels remained fairly consistent throughout the sites, with a slight increase as we got closer to the airport (about 1). The Oakland sites had a slightly higher pH (at around 9) than the corresponding San Francisco sites, at around 8 (figure 6).

DISCUSSION

Data shows an increase in levels of zinc, copper, and chromium as proximity to an airport increased, indicating that airport pollution impacts water quality. The findings presented in this study support my hypothesis that water quality will decrease as proximity to an airport increases. An excess of Chromium in bodies of water can cause harm and even death to aquatic species, particularly fish (4). Zinc and copper can cause damage to the organs and tissues of aquatic animals and may even cause death (5 and 6). Excess nitrate can cause an excessive growth of algae, which causes unstable of dissolved oxygen creates stressful conditions



and surrounding areas. Moving north away from the surrounding areas. Moving north away from the airports airports nitrate decreased and moving south away from pH increased and moving south away from the airports pH the airports nitrate decreased. Nitrate was detected at the decreased. The pH was higher at the sites in Oakland than

for fish and other aquatic species and may cause 3. Baxter, Glenn, et al. "An Assessment of Airport them to die off (7). However, I did not observe the Sustainability: Part 3—Water Management at Copenhagen expected decrease in pH, a reason for this may be because of inaccurate readings and instrument error. Alternatively, it might be that airport pollutant runoff 4. Eisler, R., 1986, Chromium Hazards to Fish, Wildlife, is not acidic, so it doesn't affect the pH, or that it and Invertebrates: a Synoptic Review, U.S. Fish and is acidic but is buffered by the existing chemistry of the water. Overall, the results of this study strongly suggests that pollution from the SF and Oakland 5. Li, X.F., Wang, P.F., Feng, C.L. et al. Acute Toxicity and airports are impacting water quality in the SF bay. Hazardous Concentrations of Zinc to Native Freshwater However, other potential sources of pollution such Organisms Under Different pH Values in China. Bull as shipping traffic and human pollution, like litter, as well as other variables, like weather, input from streams and canals, and storm runoff could also 6 Yanong, Roy P EDIS, 2010, Use of Copper in Marine influence the results. Additional testing on types of airport pollution and parameters of water quality would help to better understand how airports affect 7. "Nitrates and Their Effect on Water Quality - A Quick water quality.

Further research could include additional sampling of more sites in the Bay and of different canals that flow into the Bay, testing of more parameters, and testing at different times. This experiment would need to be tested at sites surrounding more airports in different cities and countries to see if the same results would appear and remain consistent. Further testing on the appearance of specific metals and other parameters of water quality, as well as other types of chemicals found in airport pollution, could help further clarify how airport pollution affects surrounding bodies of water. My experiment was testing for pollution from non-point sources and runoff pollution, which can be washed into bodies of water by storms. Therefore, future testing could include testing sites around SFO and OAK during different seasons and at different times of day. Taking data at times when there is more airport traffic, as opposed to less airport travel, would also be important to test. These suggestions for future research would help to further understand how airports affect water quality and aquatic life and would help the communities who depend on these bodies of water.

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