NM WRRI Student Water Research Grant Final Report
Final Report due June 30, 2017

1. Student Researcher: Andrew Letter; Eastern New Mexico University
   Faculty Advisor: Dr. Ivana Mali; Eastern New Mexico University

2. Project title:
   Monitoring water quality parameters within a known range of Western River Cooter (*Pseudemys gorzugi*) within Black River Drainage

3. Problem Statement and Objective:
   Understanding the effects water quality has on wildlife is an important part of ecosystem management. Black River is a tributary of Pecos River located in Eddy County, New Mexico. Over the past century, Pecos River and its tributaries have been a subject to continuous anthropogenic alterations (i.e., dam construction, pollution, etc.) which earned this river a nickname- the most troubled river in the U.S. (Dearen 2016). Today, the oil and natural gas industry have a negative effect on groundwater quality near Black River, which sets the ground for a study investigating how the riverine environment itself has been affected (Inoue et al. 2014). The objective of my research was to obtain water quality parameters along the upper and lower stretches of Black River, within a range of the state threatened turtle species- Western River Cooter (*Pseudemys gorzugi*; Mali 2016).

   The study investigated important water quality parameters including: nitrogen compounds (ammonium and nitrate), dissolved oxygen, salinity, pH, turbidity, visibility, temperature, as well as conductivity, oxidation reduction potential, and water depth. Black River is home to many species of plants and animals and also presents an important resource for terrestrial vertebrates. Humans continuously use the Black River for agricultural and industrial purposes, all of which are sources of nitrogen compounds to the river system. Ammonia in particular comes from living organisms, which then can transform into nitrate over time (Perlman 2017, USEPA 2013). Nitrogen compounds can cause growth of aquatic plants, affect dissolved oxygen levels, visibility, turbidity, but ammonia itself can be toxic to fish and insects if in high enough concentration (Perlman 2017, USEPA 2013). Dissolved oxygen levels can be affected by salinity and temperature. For example, high salinity or temperatures can decrease the amount of dissolved oxygen in the system (Dearen 2016, Fondriest Environmental, Inc. 2013). Oxidation reduction potential is also important as a higher ORP (+650 to 700 mV) can have antimicrobial effects in the water system (Suslow 2004). Given the interconnectedness of water quality parameters and anthropogenic effects on the river system itself, it is important to monitor these variables to help understand how these values play a role within an ecological system.

4. Methodology:
   I conducted the study from September 2016 to June 2017 along two 1500 m stretches of the Black River in Eddy County, New Mexico. Once a month, I obtained water quality parameters from the two areas of *P. gorzugi* range (Figure 1; Appendix A). The upper stretch is managed by Bureau of Land Management (BLM) while the lower stretch is privately owned. For each stretch, I collected the data at 7 sampling points that are ~200 m apart (Table 1). I obtained measurements using an YSI Model 85 for dissolved oxygen concentration, conductivity, salinity,

and temperature. In addition, I used Secchi disk to determine water transparency and water levels, and a turbidimeter to determine river turbidity. In 2017, I used YSI Professional Plus Multiparameter Instrument to obtain ammonium (NH_4) concentration, nitrate (NO_3) concentration, pH, and oxidation reduction potential (ORP). Due to logistical constraints, I obtained these parameters every other month (beginning February) with alternating pH/Ammonium and ORP/Nitrate setups. I then compared these parameters both spatially (between two stretches) and temporally (between months). Measurements were all taken at a depth of 1 meter.

Using historic water quality data provided by B. Lang allowed for the comparison of mean dissolved oxygen, salinity, temperature, and pH between the year 1997 and 2016-2017 at the lower stretch of the river (Table 2).

Results:

Figures 2-12 present comparisons of monthly mean water quality parameters between two stretches of the Black River. During December, BLM site was inaccessible resulting in lack of data. Interestingly, dissolved oxygen appeared slightly higher at the downstream (private) site throughout this study (Fig. 2) while conductivity, salinity, and visibility was consistently higher at the upper stretch (BLM; Figures 3, 4, and 5 respectively). Water temperature remained relatively similar at both sites and water levels were consistently higher at the upper stretch (BLM; Fig. 6). As expected, turbidity was higher at the lower stretch of the river (Fig. 7). pH was higher at the upper stretch while ammonium was higher at the lower stretch, except for during June 2017 (Fig. 8 and 9). Interestingly, nitrate and ORP values varied between the sites depending on the month of the survey (Fig. 10 and 11). For example, ORP was higher at the lower stretch in March but not in May while nitrate was higher at the lower stretch in March but not in April. Temporal changes did not show particular trends and vast majority of parameters remained relatively constant across months for each site. As expected, water temperature decreased from September 2016 to January 2017 and increased from January to June 2017 (Fig. 6). At the upper stretch, visibility of water was higher in September/October 2016 than any of the following months (Fig. 5). Worth noting is that at the lower stretch, dissolved oxygen increased from September 2016 to January 2017 and then gradually decreased in the following months.

Upon side-by-side comparison of the mean dissolved oxygen, salinity, temperature, and pH historic 1997 and current 2016-2017 data collected, similarities were observed for all parameters indicating that there was no significant long term shift in water quality, at least for the comparable parameters (Table 3).

5. Black River is a biodiverse system that contains many different types of organisms, including several threatened and endangered taxa such as Texas hornshell (*Popenaias popeii*), blotched water snake (*Nerodia erythrogaster*) and Rio Grande cooter (*Pseudemys gorzugi*). Obtaining water quality parameters may serve as an important component in understanding the overall productivity of this river system. In the case of Rio Grande cooter, water quality parameters can indirectly provide information on resource availability. For example, dissolved oxygen can potentially provide information on plant growth which is important given herbivorous diet of adult *P. gorzugi* and temperature gradients can be correlated to the overall activity of this freshwater turtle given that they tend to be dormant in the cold winter months. Moreover, my

research shows how drastic or minimal water parameters can be between upstream and downstream locations along the river. The information I gathered can be paired with other research projects on other taxa to assess if there is any correlation between the parameter values I obtained and ecosystem dynamics.

6. The net total of the GWRL17 budget was $5771.76. We have used these funds to purchase a YSI Professional Plus Multiparameter Instrument with appropriate probes and buffers and a Hach 2100Q Portable Turbidimeter. We have also used the funds for In-State-Travel.

7. I plan to present my research at the 2017 Annual New Mexico Water Conference in Las Cruces.

8. I am not currently preparing any reports or publications with the most recent collected data, but plan to compose a collaborative publication in the future with additional research conducted at Eastern New Mexico University on population demographics of *Pseudemys gorzugi* funded through New Mexico Department of Game and Fish- Share with Wildlife Program.

9. Student Assistants, Eastern New Mexico University:
   Jessica Curtis, Leslie Sanford, Keegan Friend, Daniel Gallegos, and Korry Waldon

10. None.

11. I am scheduled to graduate with my M.Sc. in Biology from Eastern New Mexico University in the Spring of 2018. In the future, I plan to pursue a Ph.D. in a wildlife related field and conduct research in either an academic or government setting.

Figures and Graphs

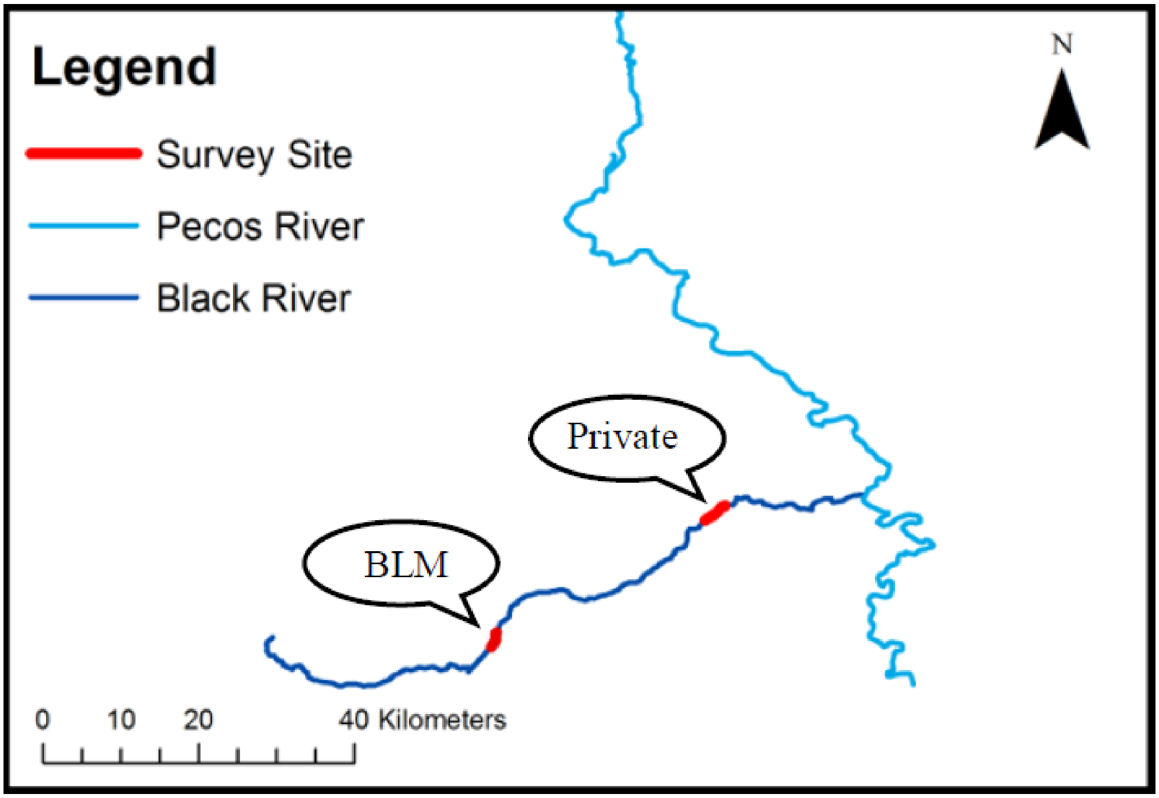

Figure 1. Two regions along the Black River surveyed for Western River Cooter in 2016 and 2017 (Mali and Forstner 2017) and the areas where water quality parameters were collected.

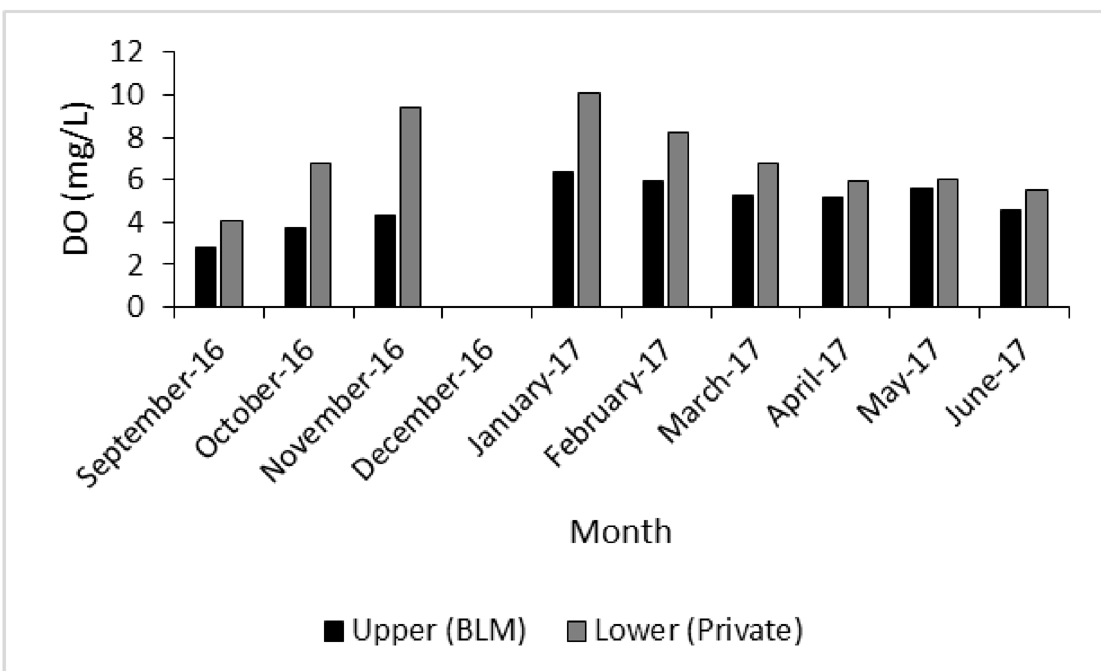

Figure 2. Mean monthly dissolved oxygen (mg/L) concentrations along upper and lower stretches of the Black River

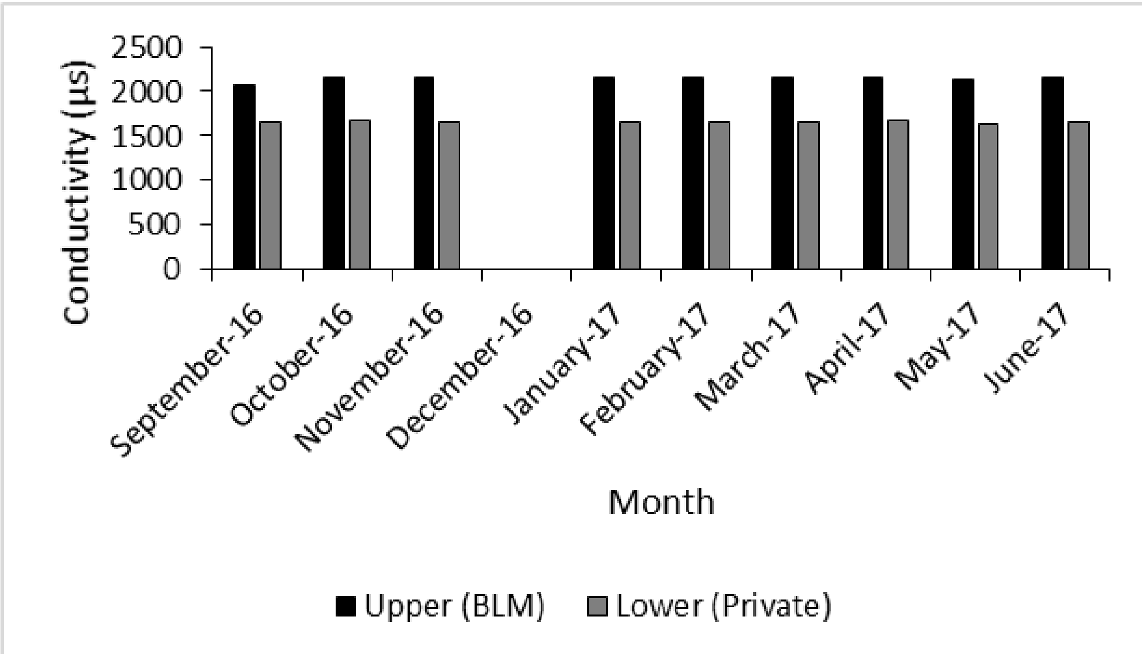

Figure 3. Mean monthly conductivity (µS) along upper and lower stretches of the Black River.

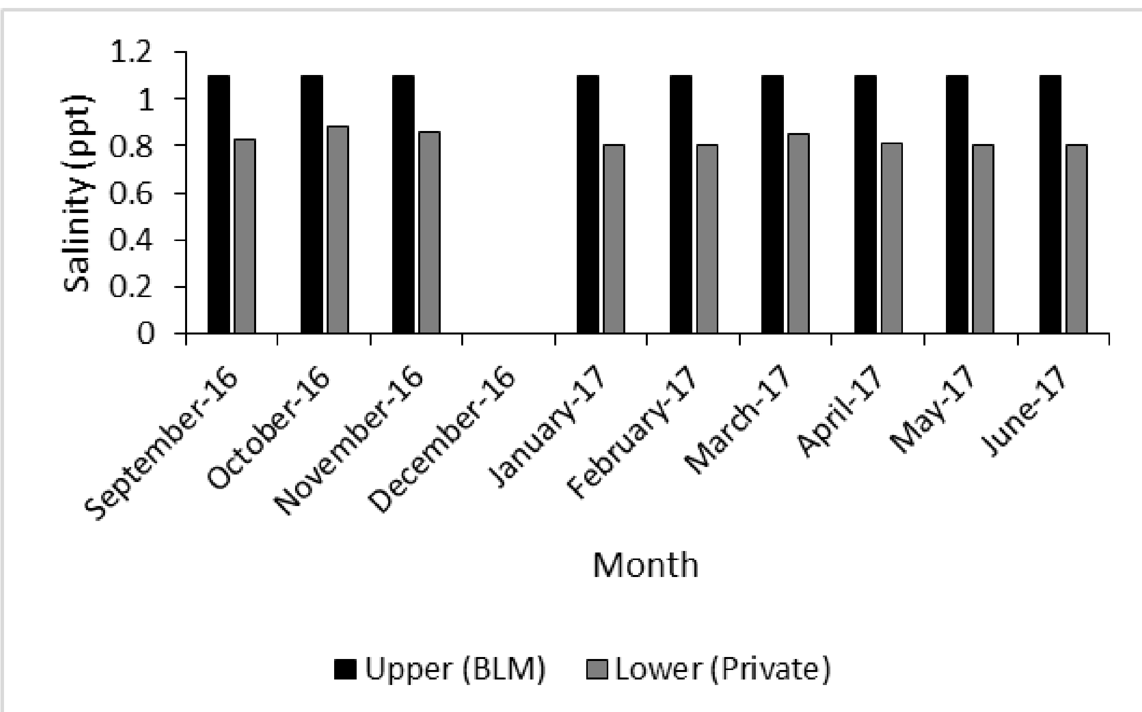

Figure 4. Mean monthly salinity (ppt) concentrations along upper and lower stretches of the Black River.

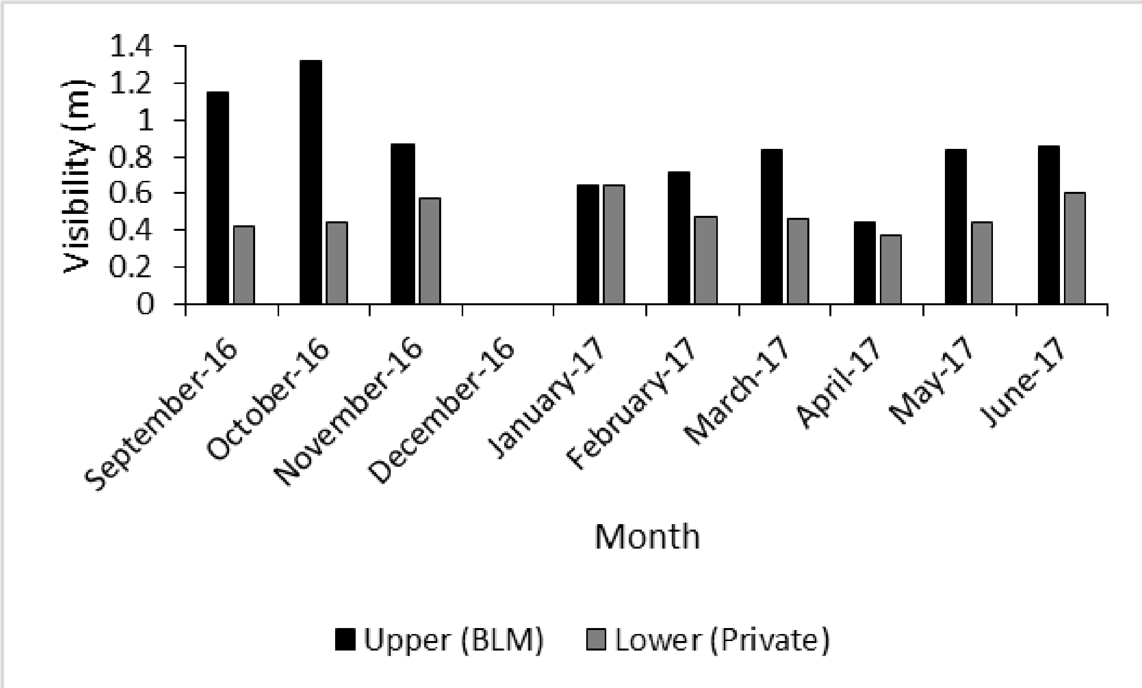

Figure 5. Mean monthly visibility (m) along upper and lower stretches of the Black River.

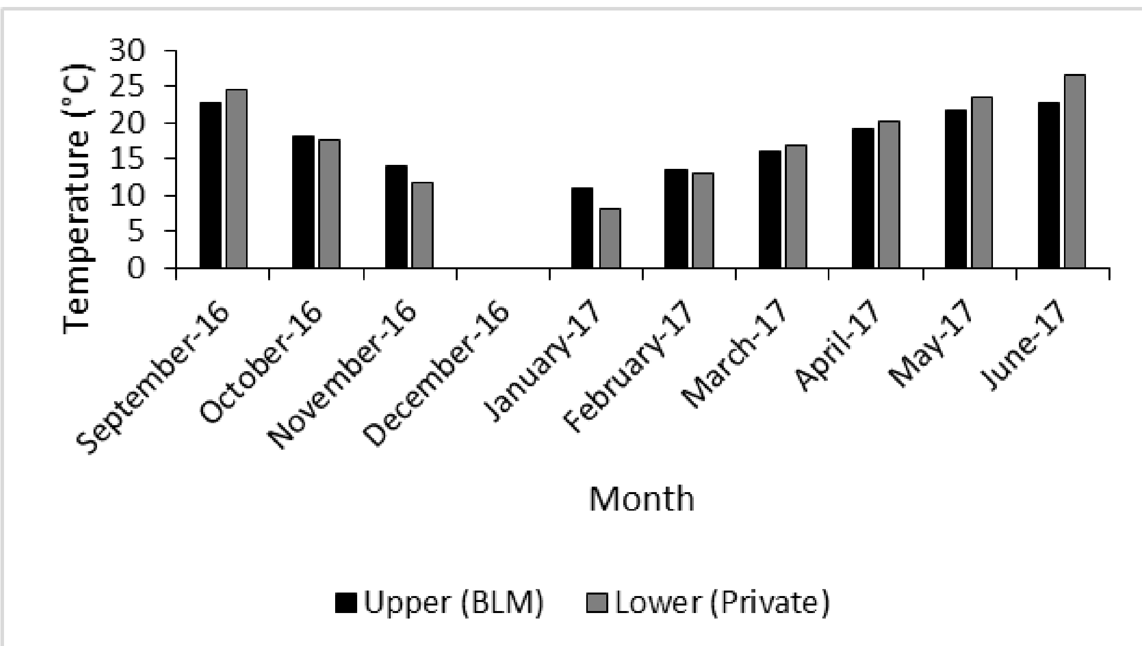

Figure 6. Mean monthly temperature (°C) along upper and lower stretches of Black River

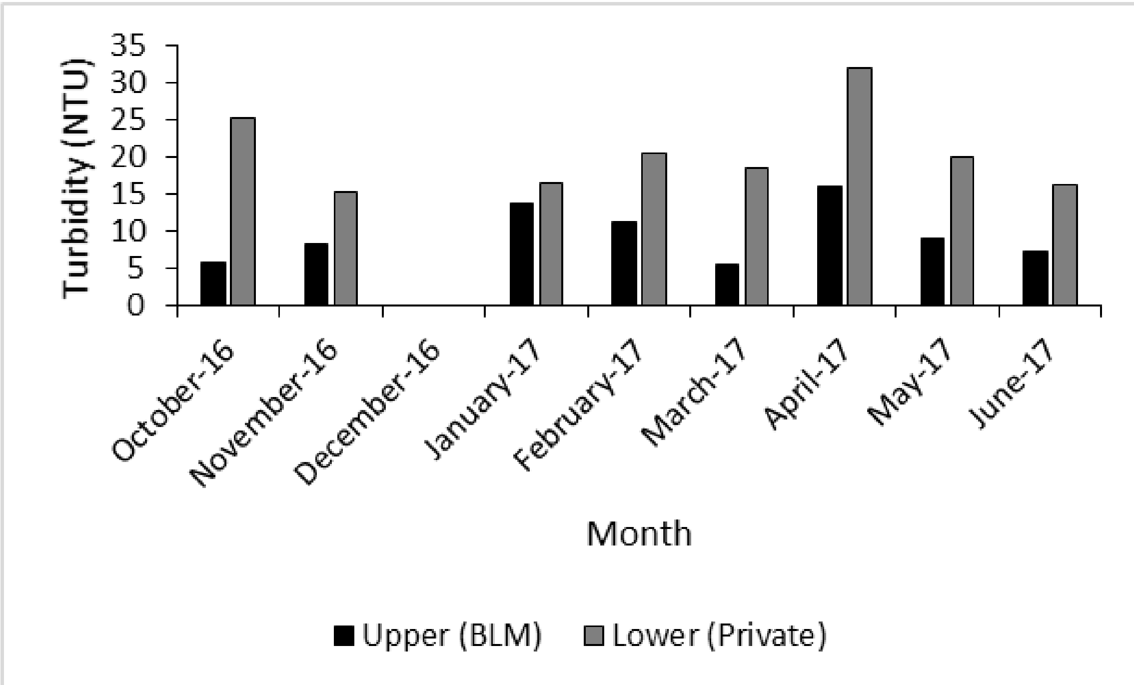

Figure 7. Mean monthly turbidity (NTU) along upper and lower stretches of the Black River.

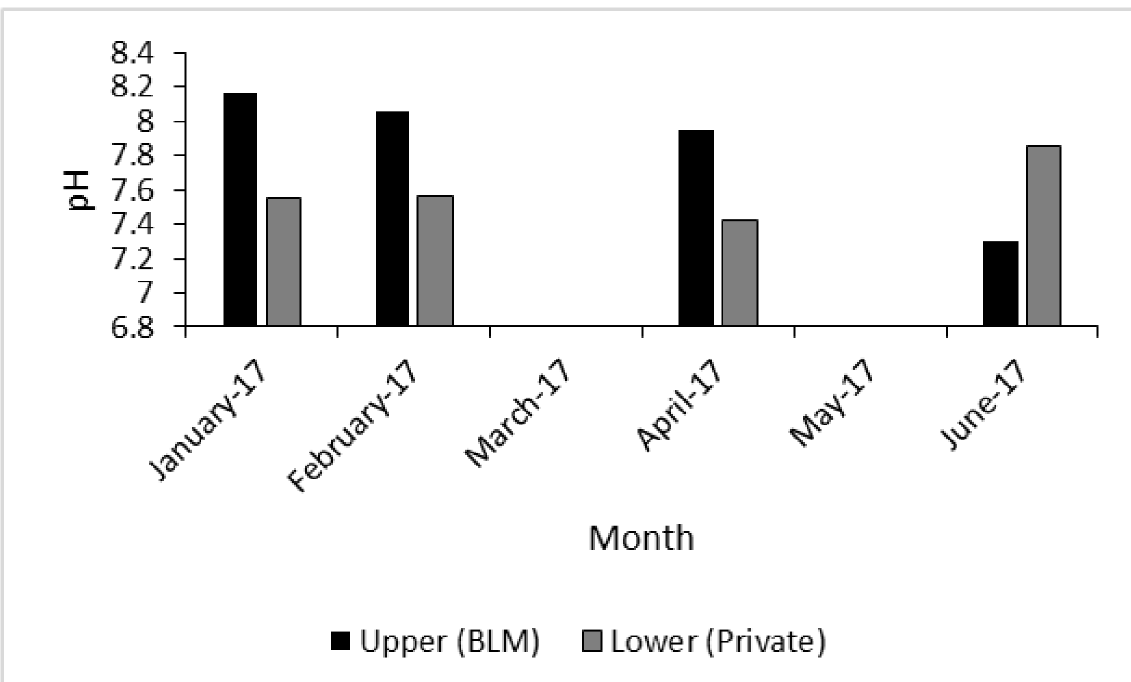

Figure 8. Mean monthly pH along upper and lower stretches of the Black River.

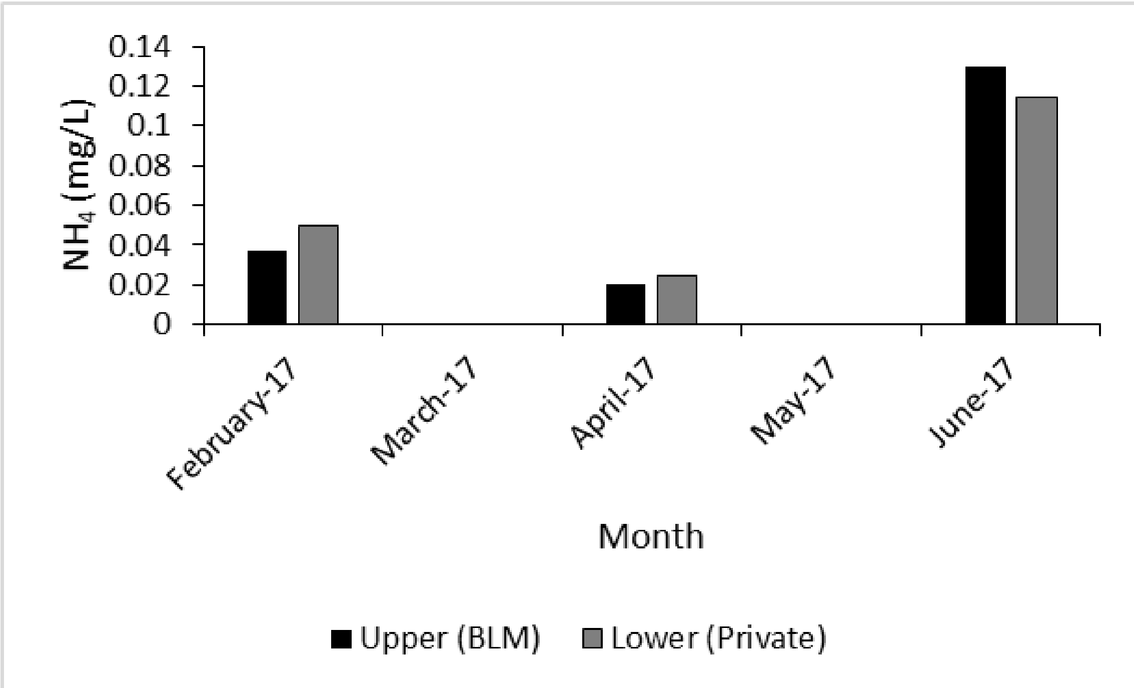

Figure 9. Mean monthly ammonium (mg/L) concentrations along upper and lower stretches of the Black River.

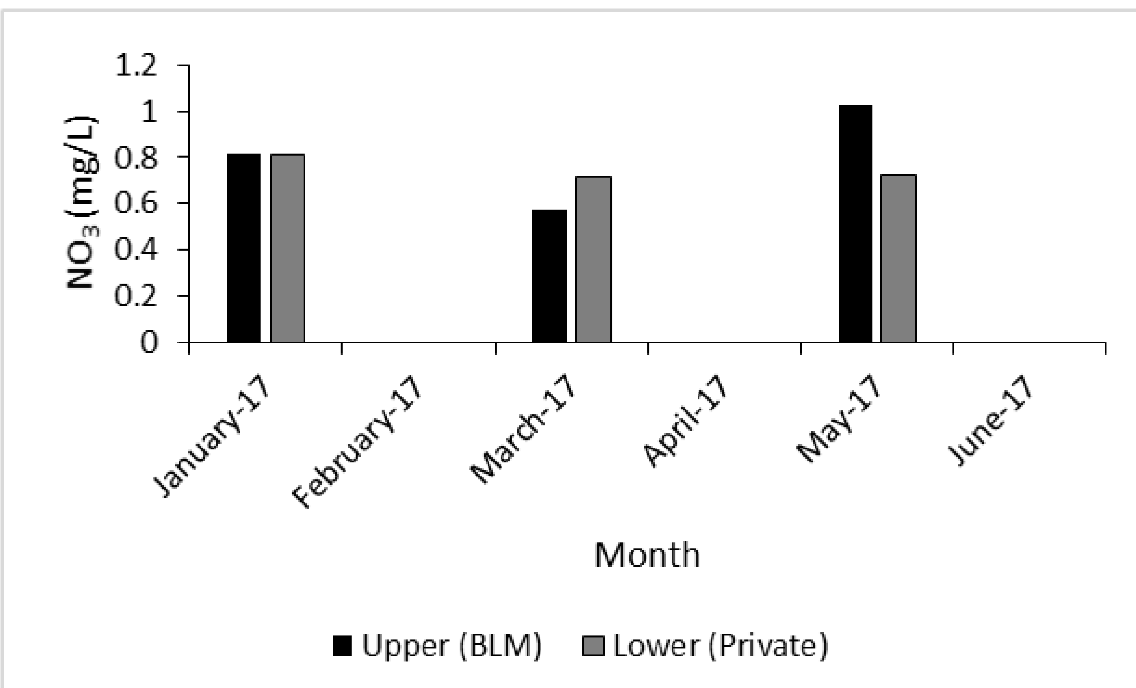

Figure 10. Mean monthly nitrate (mg/L) concentrations along upper and lower stretches of the Black River.

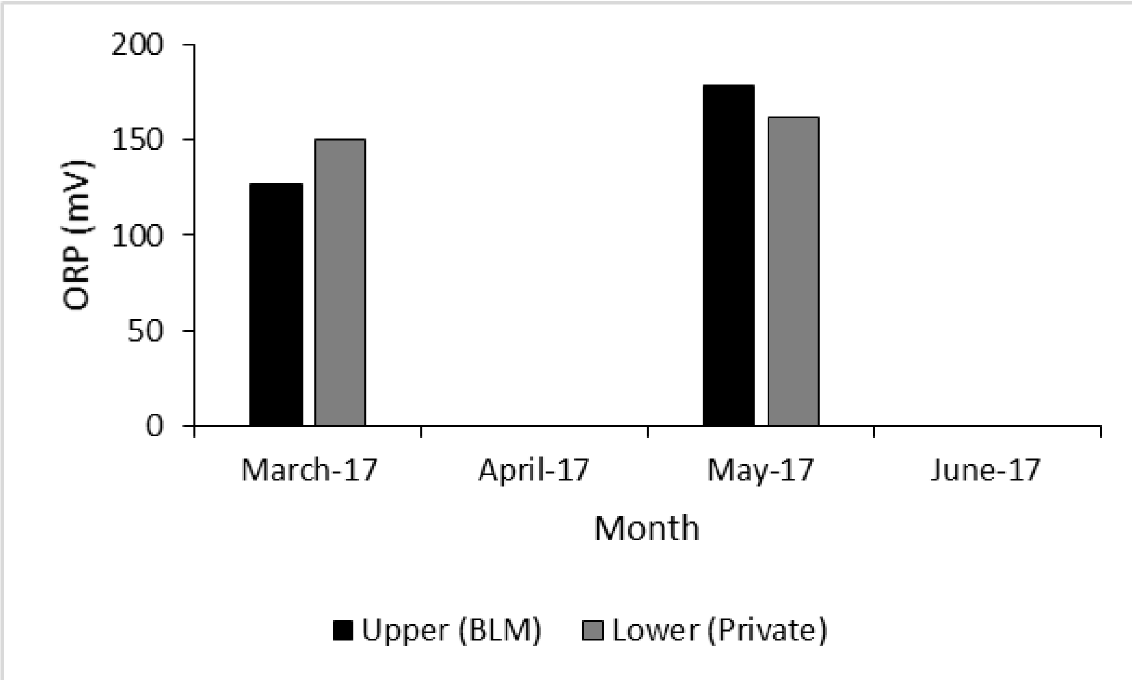

Figure 11. Mean monthly oxidation reduction potential (mV) along upper and lower stretches of the Black River.

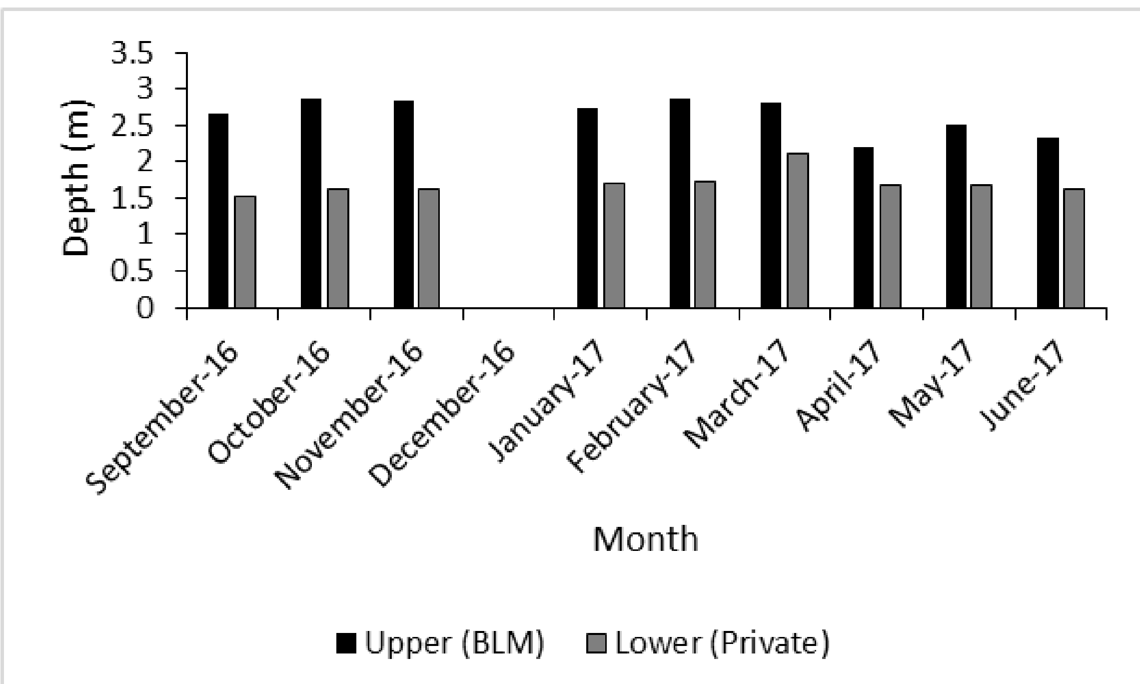

Figure 12. Mean depth (m) along upper and lower stretches of the Black River.

Table 1. GPS coordinates (WGS84) of 14 sites where water quality parameters have been collected from September 2016 to June 2017. Seven points were chosen on the upper, BLM owned, stretch and seven points were chosen on the lower, privately owned, site.

Point #	Stretch Name (upper/BLM or lower/private)	Latitude	Longitude
1	upper/BLM	N 32.08421	W -104.47307
2	upper/BLM	N 32.08228	W -104.47362
3	upper/BLM	N 32.08035	W -104.47402
4	upper/BLM	N 32.07857	W -104.47404
5	upper/BLM	N 32.07677	W -104.47369
6	upper/BLM	N 32.07472	W -104.47444
7	upper/BLM	N 32.07316	W -104.47538
8	lower/private	N 32.22431	W -104.21689
9	lower/private	N 32.22289	W -104.21825
10	lower/private	N 32.22195	W -104.22002
11	lower/private	N 32.22588	W -104.21585
12	lower/private	N 32.22717	W -104.21431
13	lower/private	N 32.21974	W -104.22296
14	lower/private	N 32.21881	W -104.22479

Table 2. GPS coordinates (WGS84) of 3 sites along the lower/private stretch where water quality parameters have been collected during September and October 1997.

Point #	Stretch Name	Latitude	Longitude
1	BL 1	N 32.2247	W -104.2171
2	BL 2	N 32.2277	W -104.2134
3	BL 3	N 32.2287	W -104.2119

Table 3. Mean dissolved oxygen, salinity, and temperature during August-September 1997 (B. Lang data) and August-September 2016 (current research). We also compare historic pH values to mean 2017 pH values.

Year	1997	2016
DO (mg/L)	6.33	5.06
Salinity (ppt)	0.8	0.81
Temperature (°C)	25.93	24.69
Year	1997	2017
pH	8.16	7.60

References

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APPENDIX A.

A Google Earth map depicting 14 points where I obtained water quality parameters along the Black River, NM in 2016/2017. Water 1-7 were located at the upper stretch of the Black River managed by Bureau of Land Management (BLM) and Water 8-14 were located at the lower privately owned stretch. The map also shows 3 points (BL 1-3) that overlap with our sites for which historic data were available.